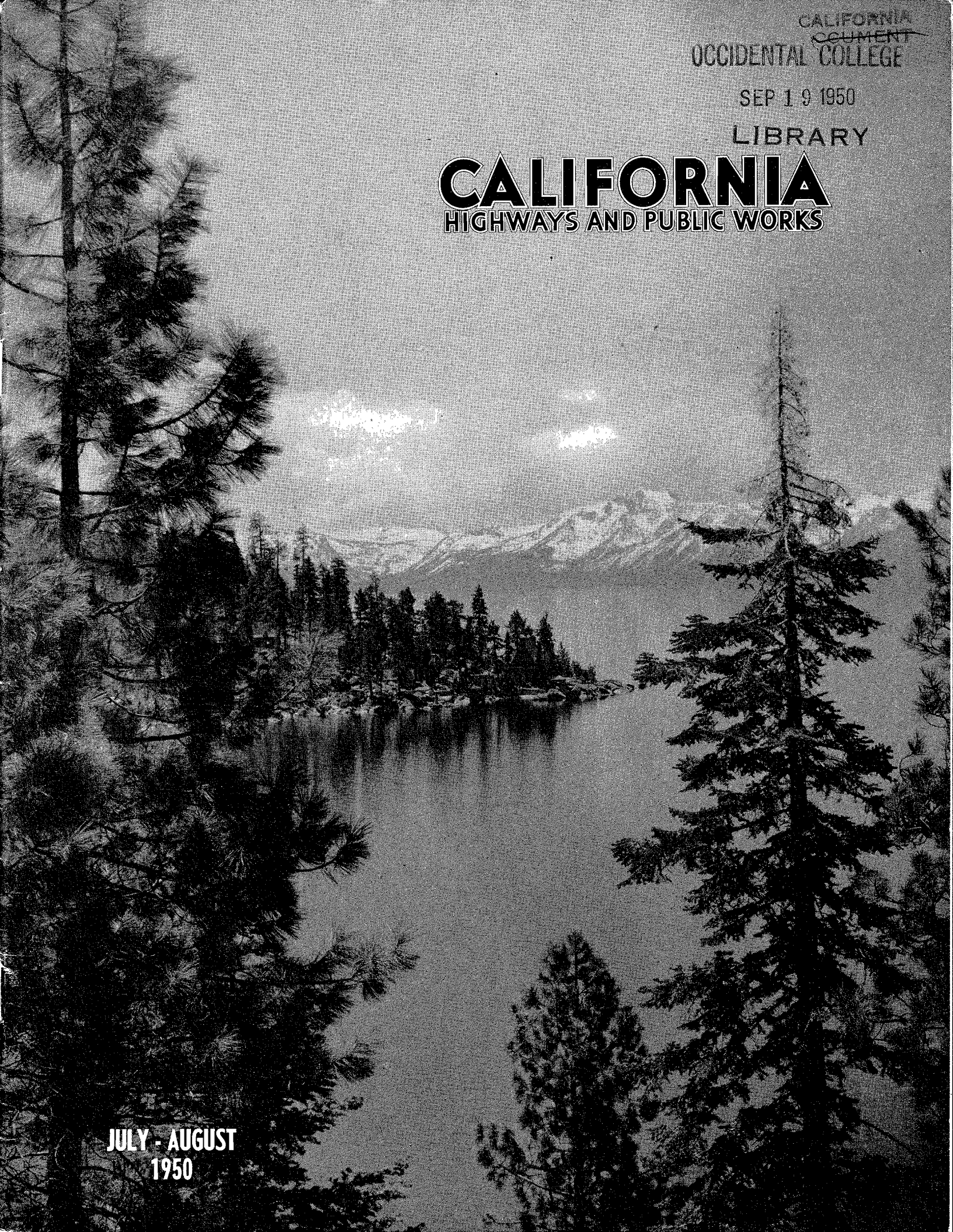
CALIFORNIA
DOCUMENT
OCCIDENTAL COLLEGE
SEP 19 1950
LIBRARY

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



JULY - AUGUST
1950

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to
CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 July-August Nos. 5, 6

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

Freeway Law

High Courts Uphold Validity of Statutes; Approve State's Power to Relocate and Improve Highways

By FRANK B. DURKEE, Deputy Director of Public Works *

QUESTIONS regarding powers of the California Highway Commission and the Department of Public Works with respect to relocation and improvement of highways and the construction of freeways—questions some of which have been raised but not conclusively answered for more than a generation – were decisively disposed of by recent decisions of the Fourth District Court of Appeal and of the Supreme Court of California. In each instance the opinion was concurred in by a unanimous court and in each instance the position of the commission and the department was upheld.

Frank B. Durkee

As further hearings have been denied in both cases, these decisions may now be considered final. Because of their importance to the highway program, it appears appropriate that they be reviewed briefly in *California Highways and Public Works.*

Sacramento County Freeway Case

The first of the cases, that of *Holloway* v. *Purcell,* 35 A. C. 226, was, in effect, an all-out legal attack on the freeway program of the State. Its basic purpose was, as was pointed out in the department's brief, to hold the present highway on its existing alignment, the plaintiff property owners assuming that thereby their roadside businesses would continue to be benefited.

The *Holloway* case arose in Sacramento County and was an action to enjoin the proposed relocation (as a freeway) of a portion of statutory Route 3 (U. S. 40, 99E) between North Sacramento and Roseville. In the superior court, Judge B. F. Van Dyke sustained a demurrer to the complaint without leave to amend and entered judgment dismissing the action. This judgment was affirmed by the Supreme Court in an opinion handed down on April 25, 1950. A petition for a rehearing has been denied.

The situation in *Holloway* v. *Purcell* is shown on the map, entitled "From North Sacramento Freeway to ½ Mile East of Roseville," which accompanies this article. The present location of the section of Route 3 involved is indicated as "Existing State Highway Route 3" and the new alignment, on which it is to be relocated, as a freeway, is in double line captioned "Proposed Relocation." This portion of Route 3 came into the State Highway System some 35 years ago as one of the original "bond issue roads"; that is, pursuant to provisions of the State Highway Act of 1909 (Stats. 1909, Chap. 383).

In the *Holloway* case, the attack on the proposed highway relocation was based on two major contentions: First, that the California Highway Commission presently is without power to approve relocation of a bond act highway; and, second, that the California Freeway Law is unconstitutional.

The court, speaking through Mr. Justice Traynor, answered the first of these contentions by saying that "there is ample statutory authority for the State Highway Commission to relocate any part of the State Highway System," citing California Streets and Highways Code, Section 71, and, also, as respects the particular section of highway here involved (which is a federal-aid highway), provisions of the Federal Highway Act to which the State has assented.

The plaintiffs had contended that "the location of Route 3 is fixed by the terms of the State Highways Act of 1909, * * *, under which it was acquired by the State, * * *, and cannot be changed until the principal and interest on the indebtedness authorized by that act has been paid."[1] They had asserted that "the statutes authorizing the relocation of state highways constructed or acquired under the 1909 act are unconstitutional on the ground that they accomplish a repeal of the provisions of that act in violation of Article XVI, Section 1 of the California Constitution." "This contention," the court said, "is without merit."

The principal argument of the plaintiffs on the question of the power of the commission to approve relocation of bond act roads appears, however, to have been based on certain language contained in Section 8 of the 1909 act providing that the highways "constructed or acquired" thereunder were to be "permanent in character" and were to be "permanently maintained and controlled by the State of California." While this language has never been interpreted by the department, or judiciously construed to have the effect contended for by the plaintiffs in the *Holloway* case, it is nevertheless true that its exact meaning has been questioned and has, in the past, been the subject of controversy.

With respect to the use in the statute of the words "permanent in character," the court said:

> "Plaintiffs interpret permanence to preclude changes from established routes. There is no support for so narrow a construction. The sentence specifically relates permanence to character of construction, not to location as is evident from the words 'finished with oil or macadam or a combination of both as in the judgment of the said department of engineering shall be most suitable and best adapted to the particular locality traversed.' In specifying hard surface materials it envisages highways that are built and maintained to endure. There is no implication that the site selected will remain forever. * * *. A duty to construct and maintain highways 'permanent in character' does not preclude relocation or realignment of highways to meet the changing needs of traffic. The sense

. . . Continued on page 30

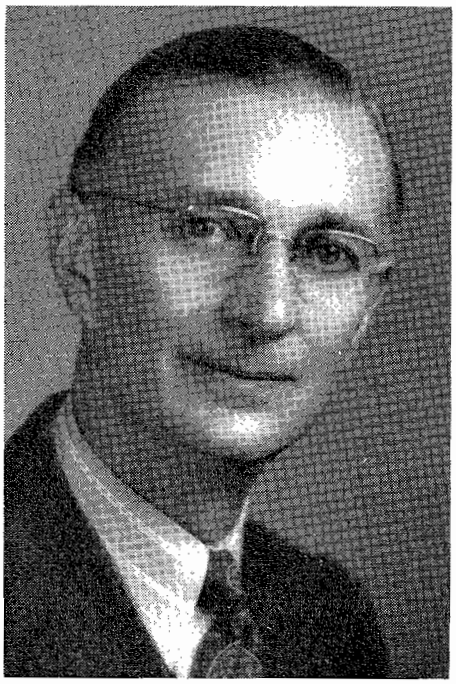
* Before appointment to his present position, Mr. Durkee served as a principal attorney on the legal staff of the Department of Public Works.—Editor.

[1] A portion of this indebtedness remains unpaid as of the present time.

Notable Career

Fred J. Grumm Concludes Long Service With Division of Highways

RETIREMENT of Fred J. Grumm, Deputy State Highway Engineer, on August 1, 1950, brought to a close an outstanding career of public service with the California Division of Highways. This service started with the California Highway Commission in 1922 at Headquarters in Sacramento,



Fred J. Grumm—1950

where he was in charge of the drafting room and supervision of design. During the last part of 1922 and first part of 1923 he was transferred to District VI, Fresno, as Assistant Division Engineer, from where he returned to Sacramento and became the Engineer of Surveys and Plans holding that position until 1943. In 1943 he was promoted to the position of Assistant State Highway Engineer and in 1947 he was again promoted to the position of Deputy State Highway Engineer, which position he held until his retirement.

Career Prior to State Service

Prior to entering state service, Mr. Grumm was employed in 1908 and 1909 with the San Diego County Highway Commission on a program for the improvement of a major county highway system. The establishment of this system was the first of its kind in the State of California and was the forerunner of other similar highway work in the State.

For a short period in 1909 and early 1910, Mr. Grumm was associated with the San Diego and Arizona Railroad. In 1910 he became Deputy County Surveyor of San Diego County and in that capacity laid the foundation for his career in road and highway work. In 1918 he returned to the newly formed San Diego County Highway Commission where he remained until 1922 when his state service started. During these years with the San Diego County Highway Commission he was in charge of office, supervision of design, estimates, plans and specifications for the improvement of highways on a major program financed by bond issue. Mr. R. M. Morton, later State Highway Engineer, was the chief engineer of this project.

In the early years of his administration of the Surveys and Plans Department it was necessary to organize the planning of highway projects on a state-wide basis. As an aid to this standardization, a Manual of Instructions was published in 1925 by the Surveys and Plans Department, which was the first publication in the State pertaining to these functions.

At this time it was the duty of the Surveys and Plans Engineer to administer the general planning of the various highway routing studies. In these early years the primary considerations were mainly those of geometric design and of alignment and gradient. Selection of type of surfacing was relatively simple, being confined either to untreated road metal, oil macadam or Portland cement concrete, placed directly on the native soil.

In making the various routing studies, Mr. Grumm obtained an intimate knowledge of the roads throughout the State, and with his good memory, these early activities have been of great assistance throughout his entire service with the Division of Highways.

Incidents During Early Trips

He recalls numerous incidents which occurred during the studies made in connection with routings of various

Fred J. Grumm—1923

state highways, some of them humorous in retrospect.

In 1925 he made a trip with Mr. Sullivan, District Engineer in San Bernardino, and Judge Van Dyke of Daggett. They went easterly across the Mojave Desert and the mountain ranges, traveling in two cars for four days. They were contemplating the junction of a route through the desert as a combination of the road entering the State from both Needles and Las Vegas, which would save many extra miles of highway construction. They were in the locality traversed by Father Garces on his explorations in the 1770's and by Jedediah Smith, one of the early mountain men, in 1826. This party named a pass after Father Garces,

which is in the most easterly and highest range of hills and is the only likely place where the crossing could have been made.

As a contrast to the trip in the desert, two weeks later Mr. Grumm was in Del Norte County picking his way through sloughs looking for a desirable location for a state highway route from the Oregon line to Crescent City.

On another early trip, made in the company of Ed Wallace, now District Highway Engineer, San Diego; Tom Stanton, now Materials and Research Engineer; Chet Warlow, present State Highway Commissioner, and Dick Downs, this group left Cedar Grove and walked over the possible location of the now Kings River Highway in the Kings Canyon. During this trip it was necessary to cross the Kings River many times and these crossings were made by wading the river and with the aid of ropes. On the second day of the hike they reached the location known as Horseshoe Bend. Finding that the water was too high to permit their crossing, it was necessary to climb the adjacent sheer bluff which is some 1,500 feet in elevation above the river. About midnight they reached the junction of the north and middle forks which was the previously selected camp site for that day.

As the entire group was exhausted, they crawled into their sleeping bags and beds without bothering to prepare any supper. During the early morning hours they were awakened to find that a skunk had gotten into their supply of steaks and the whole party was aroused, and began throwing rocks at the skunk to save the food for the much needed breakfast in the morning. The party was picked up about midnight on the third day and most of them had their clothes practically torn off and Mr. Grumm had a very severe case of poison oak, which had swollen his eyes almost shut. As he recalls, it was necessary for Mr. Warlow to accompany him to a hotel in Fresno to certify that he was even human. The finale to the whole trip occurred the next morning when they were checking out of the hotel, preparatory to returning to Sacramento. They found that all of their money had been so watersoaked due to the repeated wadings and crossings of the river that it could not be recognized and it was necessary to write a check to pay their hotel bill.

Upon another occasion, Mr. Grumm accompanied Mr. Bedford on a trip in Lake County on which they were looking for a desirable route from the Sacramento Valley to the coast. On this reconnaissance survey every canyon to the east, from the north fork of Cache Creek down to Grizzly Creek, was traversed from top to bottom. Grizzly Creek is now the location of Highway Route 15.

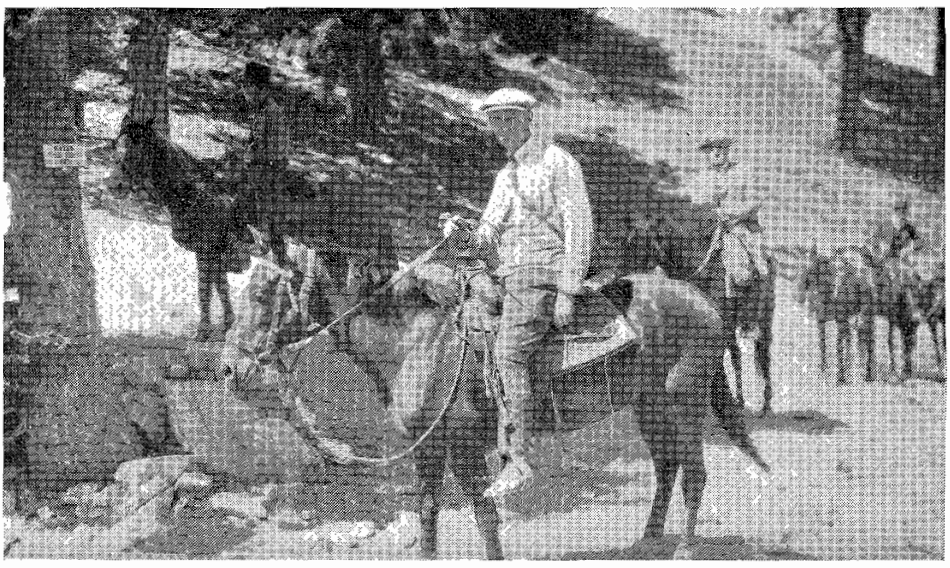
The duties as Surveys and Plans Engineer gradually developed to include work of preparing reports to the Legislature on the status and condition of the State Highway System. The associations Mr. Grumm developed through the years with various legislative committees of the House and the Senate earned for him and the department a reputation for supplying up-to-date, correct and reliable information regarding highway matters.

In 1922 there were less than 1,000,000 registered vehicles in the State of California and highway capacity was not one of the engineering problems. However, during the early 1930's the traffic on the highways had increased to such an extent that it was necessary to initiate a program for increased lane capacity. The early programs consisted of widening the existing two-lane roads to three-lane highways which was considered a standard in the early 1930's. As the traffic increased, the natural progression from the three-lane highways to a four-lane divided highway was developed. However, roadside development soon started along these routes with resulting conflict of vehicle movements, congestion, increased accidents, and reduced capacity.

In the Biennial Report of 1936 attention was drawn for the first time to a means of providing greater capacity and relief from congestion. This method contemplated the application of restriction of access from abutting property and was the forerunner of the freeway principle in California. In subsequent years further studies and discussions were carried on by Mr. Grumm as Engineer of Surveys and Plans, and with the assistance of the late Mr. C. R. Montgomery, proposed legislation was drafted which finally culminated in the adoption by the Legislature of the California Freeway Act in 1939.

Another development in the design of highways was made while Mr. Grumm was the Engineer of Surveys and Plans. The Research Department had constructed a test track and were gathering information pertaining to the supporting power of highway bases and surfacings in which the test procedure now known as the California Bearing Ratio was developed. For structural design purposes, studies

Fred Grumm on reconnaissance trip in San Gabriel Mountains in 1925



were initiated to correlate the bearing ratio test procedure and the axle loads produced by highway traffic.

The result and conclusions of the studies was published in the Public Works magazine in November, 1941, and a further amplification in March, 1942. These articles detailed the methods to be used in the structural design of highways. The details of the application of the accumulated data were principally the work of A. M. Nash, now District Engineer in District I, who at that time was in Surveys and Plans. This made the State of California one of the first to put the structural design of highways on a scientific basis.

Active in Freeway Development

The introduction of the freeway principle to the highways of California was new and revolutionary as people had always had access to traveled roads. This access was accepted as customary and a right. It was therefore necessary to undertake the freeway program carefully and slowly. The discreet application of the freeway principle to our highway improvement produced only a few examples of freeways before progress was halted by the war.

One of the first projects of this kind in California was the Arroyo Seco Freeway in the Los Angeles area. Due to the topographical features and the limited amount of property affected, it was possibile to complete a section of this freeway with a minimum of publicity in order to demonstrate its benefits to the highway users. Immediately its popularity was strikingly evident.

During the war years the planning of freeway projects became an important part of the highway work and, in the few years since the war, it has been possible to construct many miles of new highway using the freeway principle. It is Mr. Grumm's opinion that advancement along this line is indicative that we are making progress toward the ultimate in transportation.

Mr. Grumm recently prepared and presented a paper on freeways to the American Society of Civil Engineers in which he discussed the development, benefits, and future of highways constructed upon the freeway principle. This paper summarizes in a few words the primary considerations

When this photo was taken Fred Grumm (on right) was on survey trip in Kings River Canyon

which are now evident as the result of many years of study on freeway planning. This paper was published in the March-April, 1950, issue of the *California Highways and Public Works* magazine and will be in *Civil Engineering*, the popular journal of the American Society of Civil Engineers.

Throughout his entire service with the State Mr. Grumm was active in an administrative capacity with the Highway Department in the development of planning programs and policies. He represented the Division of Highways for many years in legislative matters. During the war, several weeks were spent studying the organization and efforts of the Bureau of Governmental Requirements—a bureau in the War Production Board—with Mr. Maury Maverick, Chief. This study culminated in a report to Mr. Maverick concerning the "Procedure, Certification and Priorities of Highway Projects." His recommended procedure was later adopted by the board.

One of his latest major efforts for the Division of Highways was his participation in the establishment of an expanded organization and procedure for handling the large increase of work made possible by the enactment of the recent Collier-Burns law.

Mr. Grumm has been a member of many engineering and professional organizations which include membership on the Special Committee on Design Policies of the American Association of State Highway Officials, in which he has been active since its organization; membership on the Committee on Highway Capacity and Economics of Highway Design of the Highway Research Board; American Road Builders Association; American Congress of Surveying and Mapping; the American Society of Civil Engineers (member, 1936), of which he is a past president of the Sacramento chapter; American Concrete Institute; the California State Employees Association, of which he is a charter member; the Commonwealth Club of California; the California Historical Society, E. Clampus Vitus; the American Philatelic Society, and the local Sacramento Stamp Club through which he has received awards at various exhibits; Sutter Club, Sacramento.

Mr. Grumm was born in Lyons, Iowa, and was educated in Michigan. He was married in 1911 to Lina F. Watson, and has two sons, Watson J. and Gunther S.

He proposes, during his retirement, to devote time to his hobbies and other interests which he has developed during the years. He advises that he will always be available and glad to give advice on highway engineering to the younger group of highway engineers. He says he feels safe in making this offer since nobody ever wants advice from older people.

No Parking

Visalia Protects State Highway to Preserve Usefulness as Transportation Artery

By EARLE W. TAYLOR, District Traffic Engineer

OFFICIALS of the City of Visalia, realizing the serious effect of traffic congestion on community life, recently prohibited parking along almost the entire length of State Highway Route 10 within the city, and thereby relieved an acute bottleneck on this important highway.

Prohibition of parking is no longer unique. It has become a standard prescription for certain traffic ills. The Visalia action, however, is believed without precedent among smaller cities of California in more than one respect. It is also an excellent illustration of vision and courage on the part of community leaders.

Situation in Visalia

Visalia lies eight miles off the beaten path of U. S. 99, but is not spared the headaches of acute traffic congestion, as are many cities so located. Route 10 (Sign Route 198) is the most important of the three state highways passing through the city. It alone carries almost as much traffic into Visalia as the other 18 state and county road entrances to the city combined. Yet serious deficiencies of width still handicap its users. It is advantageously located to serve the city, as it passes through Visalia in a straight line parallel to but only three short blocks from the main business street. A relocation of it to by-pass a congested area would only result in increased travel distance for thousands of drivers.

Mineral King Avenue, as Route 10 is known locally, consists of three different pavement widths. Only the westerly 0.5 mile portion was omitted from the parking restriction, as it is a rural-type divided highway only half width within the city by reason of a recent annexation. Through the 1.85-mile balance of this route within the city, parking is now prohibited. The magnitude of the restriction invoked at one time is one of the unusual features of this case.

Uncommon Aspect

From Mooney Boulevard easterly for 0.4 mile this street is a modern four-lane, divided highway with curbs and paved parking strips. Prohibition of parking along such a highway through a sparsely developed area of mixed residential and commercial structures, well in advance of acute need, provides another uncommon aspect. City officials appreciated that even along a four-lane highway parking is undesirable in that each parking maneuver interferes with the free use of the outer lane. They realized that elimination could be secured with much less opposition, if proposed before parking became extensive.

Farther east exists a 0.3 mile section of four-lane, undivided highway paved 61 feet wide between curbs and bordered by both business structures and dwellings. The remaining 1.15 mile section to the easterly city limit is paved full width but is only 46 feet wide between curbs. Roadside development is a dense mixture of older dwellings and business structures. It was this narrow section in which relief from congestion was most pressing.

Average daily traffic volumes vary from 7,000 vehicles at the east city limit to about 12,000 vehicles near the heart of the city.

Type of Establishments

Most of the 52 nonresidential establishments on Mineral King Avenue exist along this narrower section. Only 27 percent of them are types, such as service stations, that cause little curb parking. The remainder include, in addition to retail stores, many important establishments providing community-wide services and which generate heavy parking demand.

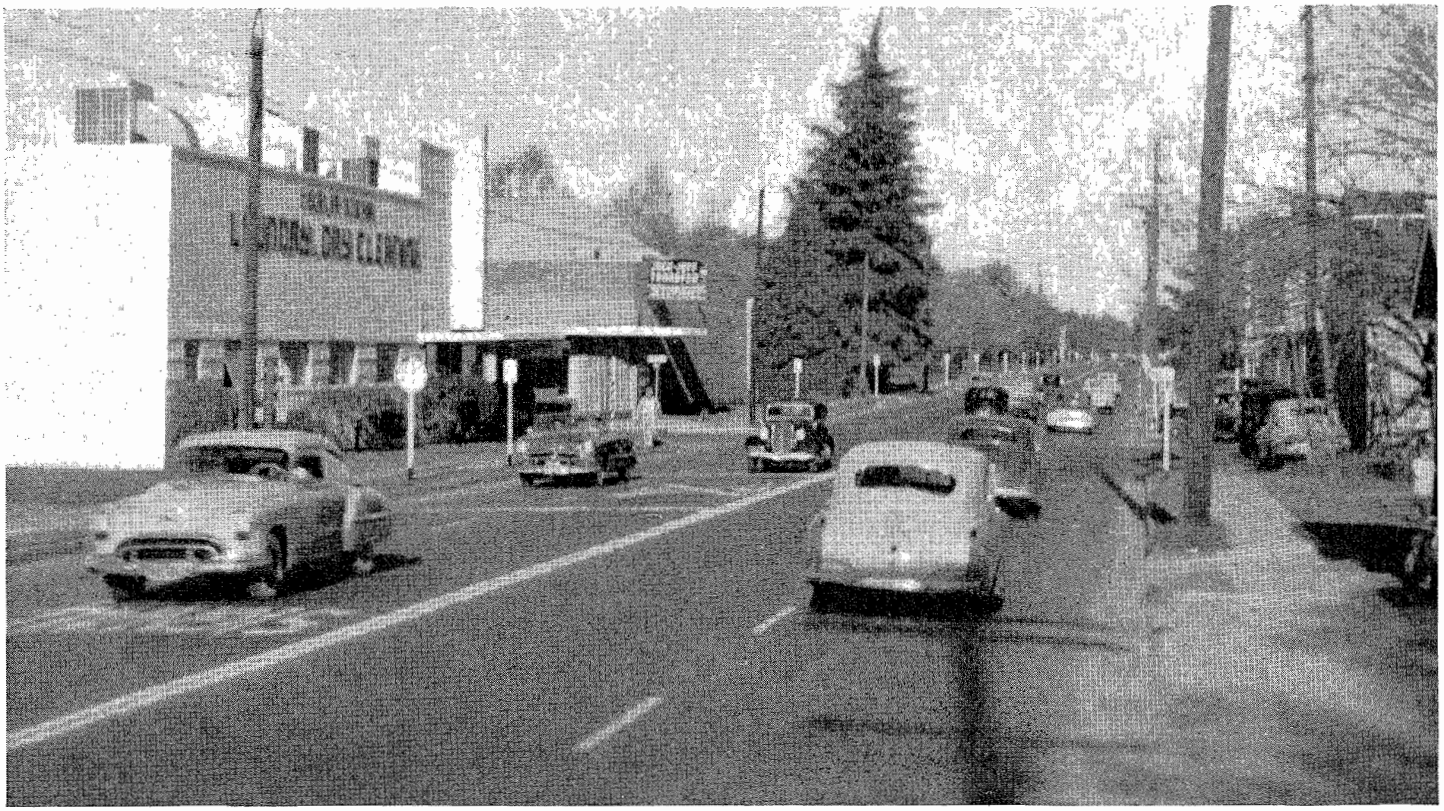
Although curb parking was not as extensive as in a central business district, parked vehicles were nevertheless spaced close enough to effectively deny moving traffic the use of the curb lane. Only enough pavement width remained for two lanes. When a vehicle performed a parking or unparking maneuver, one lane was blocked to moving traffic. This situation, combined with heavy moving traffic, inevitably resulted in congestion, delay and hazard. The 1949 accident rate in terms of accidents per million vehicle miles was nearly four times as great in this narrow section as through the four-lane portion. The elimination of parking has made four lanes available for moving traffic through the narrow section.

City Officials Act

On such a street, the mere removal of curb parking is not a complete or permanent solution. Soon four, and eventually even six, wider lanes must be provided. A dividing strip must separate opposing traffic and provide a protected storage lane for left-turning vehicles. Access from adjoining property to the through lanes must be restricted. Realizing that such an improvement was still some distance in the future, city officials acted and acted boldly to retard the creeping paralysis of congestion until a modern highway can be constructed.

As the volume of traffic steadily increased, so also did the frequency of complaints regarding delays and hazards received by city officials from owners of adjacent property and users of the street. Some time ago Mayor Jack L. Davis, City Manager E. A. Dunn and other members of the city council started an intensive study of the situation and reached the conclusion that complete elimination of parking was the only answer until the street could be widened. Consultations were held with Division of Highways engineers, who furnished factual traffic data to aid the study.

Next, civic leaders were enlisted and the detailed study was completed as a



Mineral King Avenue in Visalia now is handling a heavy flow of traffic without congestion due to elimination of parking

joint project of these men, the organizations they represented and city officials. The probable effect on each roadside enterprise was carefully evaluated. It was found that for all businesses located on corner lots, ample curb parking space existed on uncongested side streets. Some others already had off-street parking lots and still others had unused space available for such use. Those for which a satisfactory solution was not apparent were few in number.

Support From Organizations

Two men in particular gave great assistance to city officials in developing and putting the plan into effect. Mr. H. T. Lewis, District Manager of the Automobile Club of Southern California, acting in this instance as Chairman of the Highway Committees of both the city and the county chambers of commerce, exerted great influence. Mr. Charles S. Ehrhorn, Chairman of the Tulare County Chamber of Commerce, placed not only the weight of his organization behind the plan but also his own personal prestige as an authority on highway transportation. Mr. Ehrhorn is also Vice Chairman of the Transportation and Highway Committee of the San Joaquin Valley Council, State Chamber of Commerce. These men and others did much to popularize the proposal. Much data was released to the local press regarding the seriousness of the traffic situation and the large benefits to be gained by the parking ban in relation to the small number who would be hurt by it. After the public was more completely informed of the plan, the ordinance was introduced at a regular meeting of the city council.

Prior to the vote, the proposed ordinance was submitted to and approved by the State Division of Highways, and this fact was locally publicized. To operators of many individual establishments recommendations were made. It was pointed out to the pastor of the First Baptist Church that at times of services a free municipal parking lot located less than a block away was being very little used. A subsequent announcement from the pulpit caused a mass changeover from curb to off-street parking. As a result of a similar suggestion the many people attending the almost nightly meetings held in the Masonic Hall now use a nearby municipal lot.

Ordinance Passed

Two weeks later the ordinance came up for hearing and vote, and was unanimously passed. *Not one citizen spoke in protest at either council meeting.*

It is not only the length of the section of street involved that is so noteworthy but also the radical change in situation. Most cities proceed cautiously in such matters. They move progressively but slowly from unrestricted parking to time limit parking, then to peak hour prohibition, arriving at long last at complete prohibition of parking at all times. Officials of Visalia, however, acted more boldly. They changed this street in one drastic move from unrestricted parking to complete elimination of it, because the need for taking this step was so apparent.

Soon after passage of the ordinance, an unexpected phenomenon was observed. Although the restriction could

... Continued on page 43

A Treatise

Experimental Use of Lime for the Treatment of Highway Base Courses

By ERNEST ZUBE, Associate Materials and Research Engineer *

INTRODUCTION

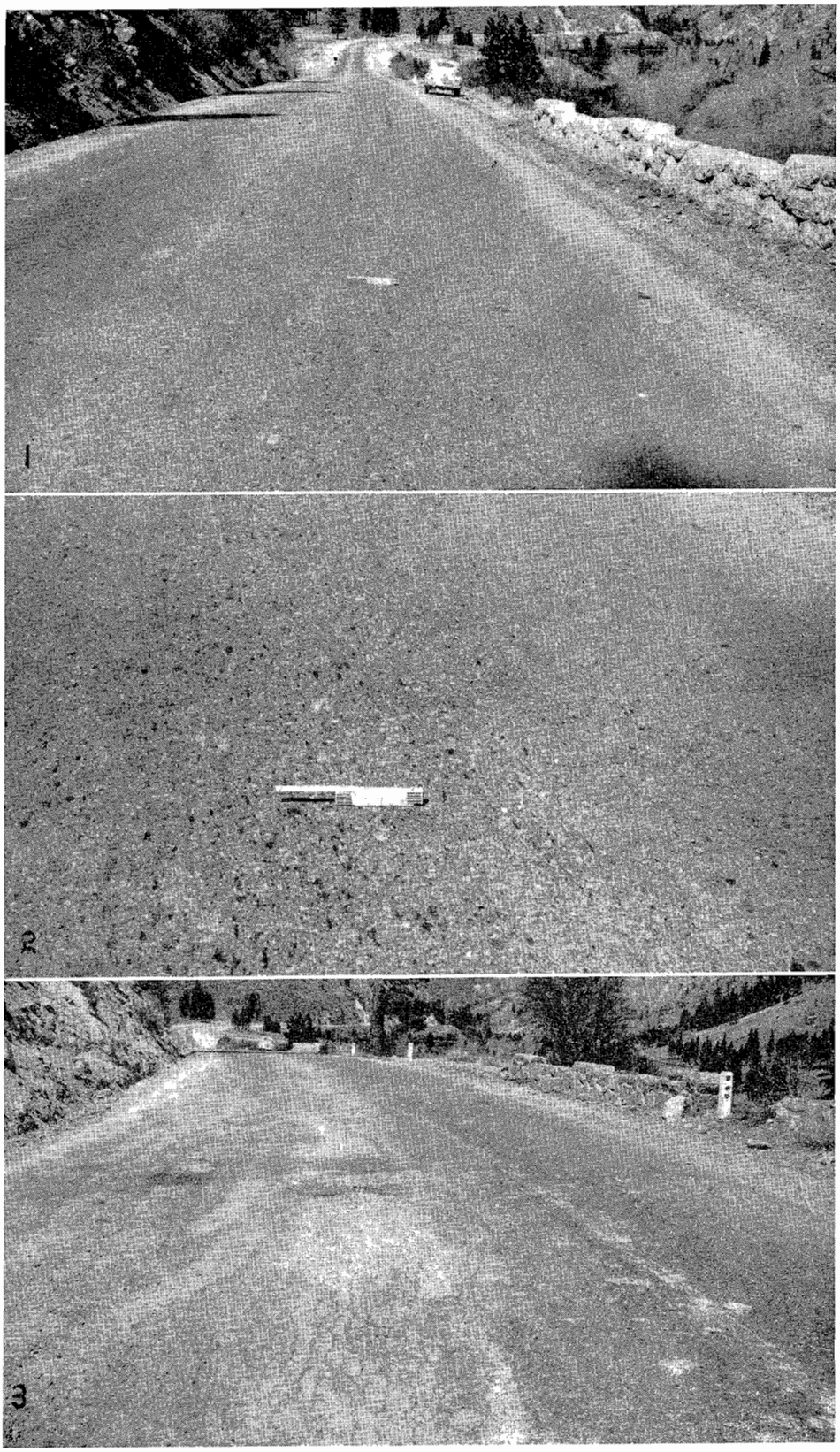
FROM THE EARLIEST times, both the builders and users of roads have recognized that there are vast differences in the character of soils and in their native suitability for highway purposes.

The highway engineer is fortunate when stable soils are encountered or where good granular base material is cheaply available. However, the cost of importing suitable materials and the problems of correcting weaknesses in existing roads have caused many engineers to consider means for improving the properties of whatever soil is encountered. Such artificial treatments are generally referred to as "soil stabilization" and a great many processes including the use of natural and artificial additives have been proposed and tried out.

Clay Soils and Sand

Clay soils have been stabilized by admixing with sand and sands have been improved through the addition of clay binders. However, it is very difficult to achieve an entirely satisfactory balance. Artificial binders such as asphalt, Portland cement, calcium chloride, etc., have been used with varying degrees of success.

One of the most useful road building materials is natural limestone which has long been highly regarded for its stable and enduring qualities. It has also been observed that soils are rendered more friable and their properties of stickiness and plasticity reduced by the admixture of finely ground limestone or hydrated lime. Therefore, the possibilities of improving native materials by the admixture of finely divided lime have been investigated in several areas.



TOP—Section treated with 2 percent lime in August, 1948. Photo shows appearance in April, 1949. CENTER—Closeup of same section. LOWER—Failed section not treated with lime. This section was in satisfactory condition in August, 1948, but failed during the following winter

* Prepared for the Committee on Lime-Soil Stabilization of the American Road Builder's Association Meeting at Cincinnati, Ohio, March 6, 7, 8, and 9, 1950.

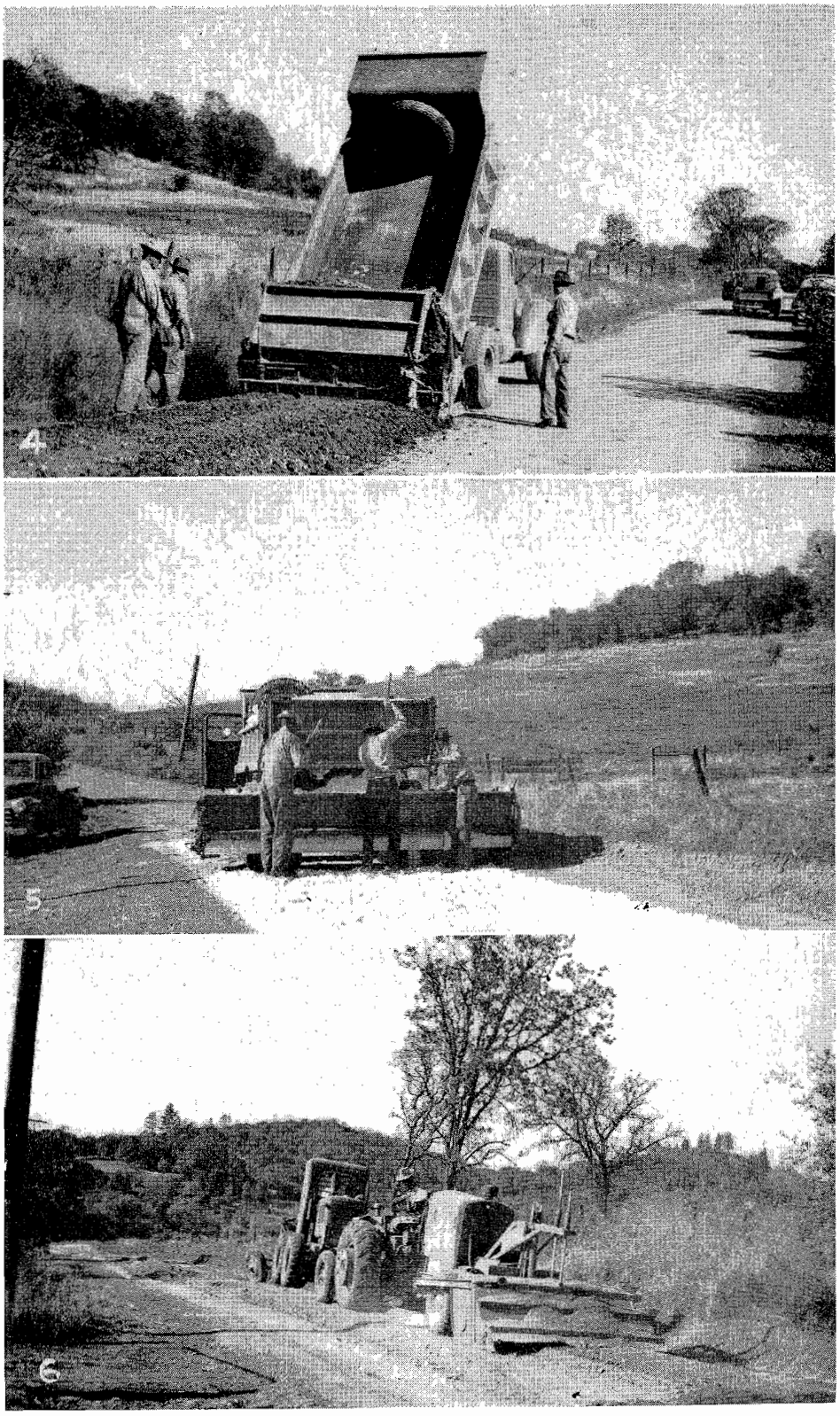
Experiences Elsewhere

Experiences with lime treatment have been reported from the State of Texas and elsewhere and experimental work has been conducted in the Materials and Research Department of the California Division of Highways in order to determine the relative effectiveness of lime treatment. While the results of laboratory experiments indicated that many poor materials were improved by the addition of lime, it also appeared that the cost of commercial hydrated lime was somewhat greater than the cost of Portland cement, for example, and it was not evident from laboratory tests or from reports of field experiments that the lime treatment was necessarily superior to that obtained with Portland cement.

During 1948, an opportunity was afforded to construct two experimental sections in State Highway District III, headquarters at Marysville, California. A supply of agricultural waste lime was available in bulk quantities from the Diamond Springs Lime Company near Placerville, California, at a price considerably less than that of Portland cement and this lime was used on one project. On the other project the more expensive commercially available agricultural lime, packaged in 100-pound bags, was used. This report covers the essential details and observations to date on these two projects located in the Sierra Nevada Mountains east of Sacramento in which agricultural lime was added to natural granular base materials for the purpose of decreasing the plasticity and thus increasing the stability and the load carrying capacity.

SYNOPSIS

The first field project is located on Road III-Nev-38-B near Truckee, California, situated in the Sierra Nevada Mountains, at an elevation of about 5,800 feet, a few miles west of the Nevada State Line. This project was constructed in August, 1948. Two percent of agricultural lime of the type sold commercially in 100-pound bags was added to a four-inch layer of granular base material by the road-mix method. After spreading and compacting, the treated base was covered with three inches of bituminous surfacing. The cost of the lime used was roughly comparable in cost to a similar treatment with Portland cement. Thus far, the treatment appears to be successful.



4—Spreading the untreated base rock. 5—Spreading agricultural bulk lime. 6—Mixing with pulvomixer and blade

The second project is located on Road III-ED-93-B, between Cool and Georgetown. This section is located on the western slope of the Sierras at a lower elevation than the Truckee proj-

ect. Work was started in October, 1948, but was only partially completed that year due to inclement weather. Bulk agricultural lime was obtained from reject piles at the Diamond Springs Lime Company in Placerville and was added to the base material in amounts equal to 4 percent by weight. A light penetration treatment of asphaltic oil was applied as a wearing course. This lime treatment represented a saving of approximately 35 cents per ton of soil treated when compared to a similar treatment using Portland cement.

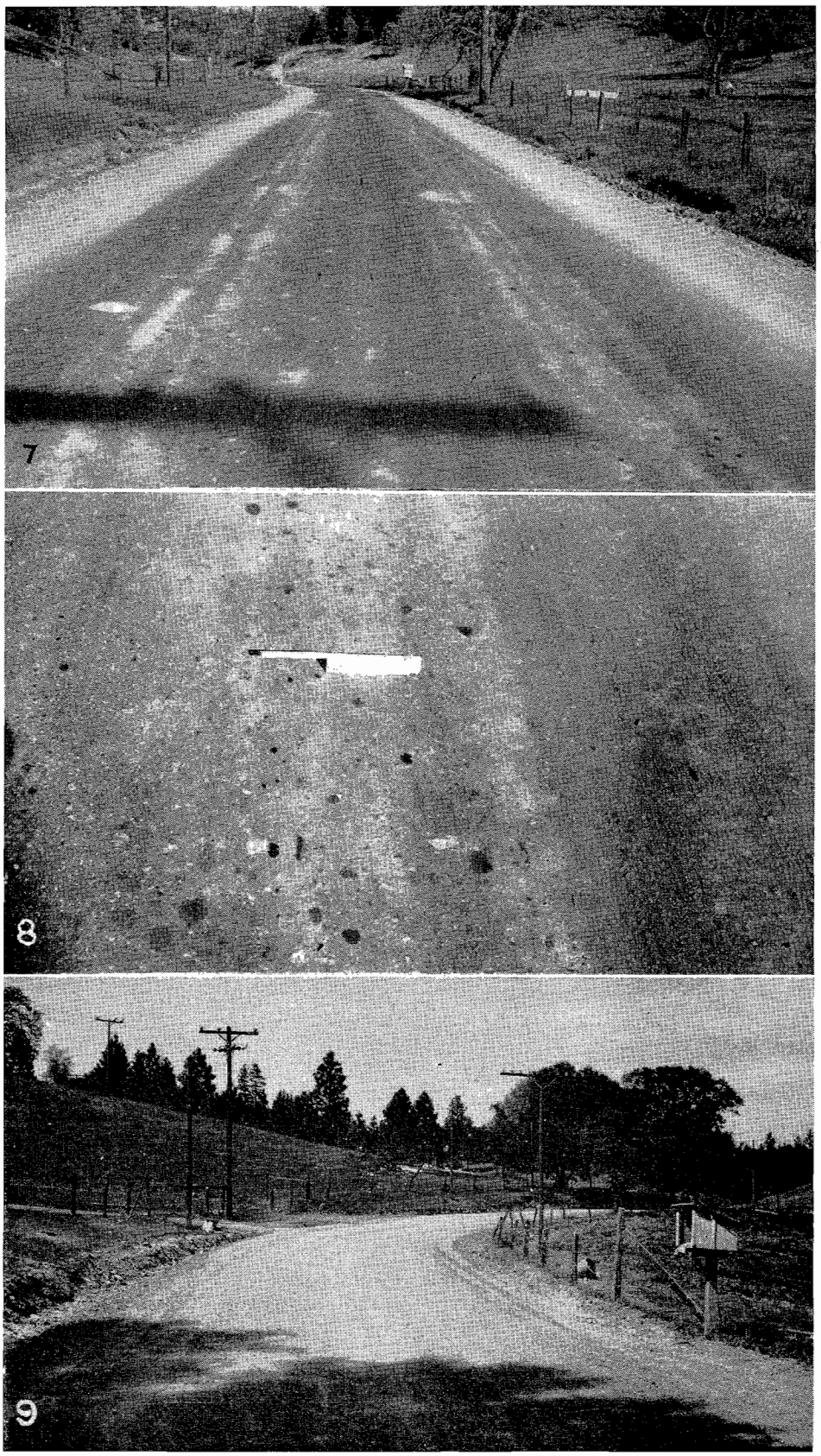
Both projects were inspected by representatives of Headquarters Laboratory in 1949 and again early in 1950 and it was found that the stabilized base material was giving satisfactory service in each case with little or no evidence of distress after being subjected to comparatively heavy traffic through at least one full and one partial winter season, the winter of 1948-49 was characterized by the heaviest snowfall and the lowest temperatures occurring in this locality. Samples of the lime treated base material taken from both jobs showed it to be nonplastic when tested.

In the spring of 1949 when first inspected it was observed that adjacent areas on both projects where the base material was not treated with lime gave evidences of marked deterioration during the previous winter.

TRUCKEE JOB

A short experimental project using lime as a stabilizing agent in the base material was constructed by maintenance forces during the month of August, 1948, near Truckee on Road III-Nev-38-B, between Bocca and Sierra County Line.

After the spring of 1948, four sections of the road located between stations 180 and 368 and ranging in length from 700 feet to 1,400 feet had become distorted, due to base failure, to such an extent that major repairs were necessary. Material from an existing stockpile on the roadside (Test No. 48-3239) which was proposed for use as base showed a Plasticity Index (P. I.) of 12 when tested. The addition of 2 percent lime rendered this material



7—New six-inch base material with penetration oil treatment. Placed November, 1948. Appearance in April, 1949. 8—Closeup of same section as above. 9—New six-inch base material which went through winter without oil treatment. Appearance in April, 1949

nonplastic. It was therefore decided to use this lime treated aggregate for the new base.

During construction operations the old bituminous surface was salvaged insofar as possible. On Sections 1 and 2, the existing base was removed and wasted and replaced with sufficient new base material from the above stockpile for a layer approximately four inches thick. For Sections 3 and 4 it was decided to scarify and treat the existing base material. Two percent by weight of bagged agriculture lime was then added to the base material on all four sections. (*See Table I.*)

TABLE I

Section number	Length, feet	Treatment
1 (W. end)	1,440	2% Lime, new base material, 14′ wide treated
2	700	2% Lime, new base material, 24′ wide treated
3	1,050	2% Lime, existing base material treated, 12′ wide
4 (E. end of job)	700	2% Lime, existing base material treated, 20′ wide

The material was mixed with a motor patrol, water added as required, then spread with a blade and compacted with a roller. The old surfacing, after some reprocessing, was relaid to a thickness of 2 inches to 2½ inches and topped with a thin blanket of new SC-3 plant mix ½ inch to 1 inch thick, providing a total bituminous treated surface thickness of approximately 3 inches.

Type of Lime

The lime used on this job consisted of commercial agricultural lime with about 85 percent passing the 200-mesh sieve and was supplied in 100-pound paper bags. The initial cost of the lime was approximately $20 per ton f.o.b. Placerville and including the freight to Truckee the cost was about $23.50 per ton. It was obtained from the Diamond Springs Lime Company near Placerville. For the purpose of comparison, the cost per sack of cement in Truckee is approximately $1.25 or $26.50 per ton, based on small quantities.

Tests made on three samples of the lime-treated base material taken from the road on October, 1948, about two months after construction, showed the material to be nonplastic with R Values * of 83 and 84. Three additional samples were obtained in April, 1949. One from Section 1 where the new base material was used, one from Section 4 in which the existing base material was treated and one from a failed area (not lime treated, adjacent to Section 4) which should represent the existing base material prior to stabilization with lime; this failed area was in satisfactory condition in 1948. The two lime treated base materials proved to be nonplastic with R Values of 85 and 86. Tests on the untreated base material showed a P. I. of 18 and an R Value of 67. (*See Table II* for test results.)

CONCLUSION

An inspection on April 20, 1949, of the four stabilized sections constructed in August, 1948, showed them to be in good condition. Samples of the treated base material were nonplastic and when tested in the stabilometer gave satisfactory R Values. The sample taken from an area showing distress and adjacent to one of the stabilized sections showed a Plasticity Index of 18 and an R Value of 67, both of which are considered unsatisfactory for a base material. This area was in satisfactory condition in August, 1948, but failed during the following winter.

* R Value = Resistance value of the soil as determined in the Stabilometer. See "The Factors Underlying the Rational Design of Pavements" by F. N. Hveem and R. M. Carmany. Proceedings of the Twenty-eighth Annual Meeting of the Highway Research Board, December, 1948.

TABLE II

TEST RESULTS OF SAMPLES

III-Nev-38-B

Date sampled	Test number: U No.	Test number: Aggr. Dept. No.	Test number: Dist. No.	Treatment	Grading % Pass: ¾	Grading % Pass: #4	Grading % Pass: 200	Grading % Pass: 5 u	Grading % Pass: 1 u	P.I.	R Val	Density lbs./cu. ft.	Remarks
7/21/48	------	48-3239	--------	CRB—None	88	48	12	3	1	12	----	----------	Mystic Pit Material
				2% Lime added	----	----	----	----	----	NP	----	----------	Preliminary sample
				4% Lime added	----	----	----	----	----	NP			
				2% Cement added	----	----	----	----	----	3			
				4% Cement added	----	----	----	----	----	NP			
10/ 7/48	540	48-4540	R-2-X	2% Lime added	82	49	----	----	----	NP	83	120	Sampled from roadbed
10/ 7/48	541	48-4541	R-3-X	2% Lime added	84	50	----	----	----	NP	84	120	Sampled from roadbed
10/ 7/48	542	48-4542	R-4-X	2% Lime added	80	46	----	----	----	NP	84	121	Sampled from roadbed
4/20/49	1,027	49-2412	--------	2% Lime added (Section 1)	----	----	----	----	----	NP	85	----------	Sampled from roadbed
4/20/49	1,028	49-2413	--------	2% Lime added (Section 4)	----	----	----	----	----	NP	86	----------	Sampled from roadbed
4/20/49	1,029	49-2414	--------	No lime treatment	----	----	----	----	----	18	67	----------	Sampled from failed area

The preliminary test indicated that the addition of 2 percent of cement reduced the P. I. to 3. It is quite possible that by adding 2.0 to 2.5 percent cement to the base material results similar to that of the lime treatment could have been obtained. Due to the high price of the bagged lime ($23.50 per ton) no significant savings over cement treatment was achieved. However, the lime treatment showed satisfactory results and produced a stable base which has carried comparatively heavy traffic during one of the wettest winters in that locality.

A recent inspection, made in February, 1950, showed that the lime-treated sections continue to be in excellent condition.

GEORGETOWN JOB

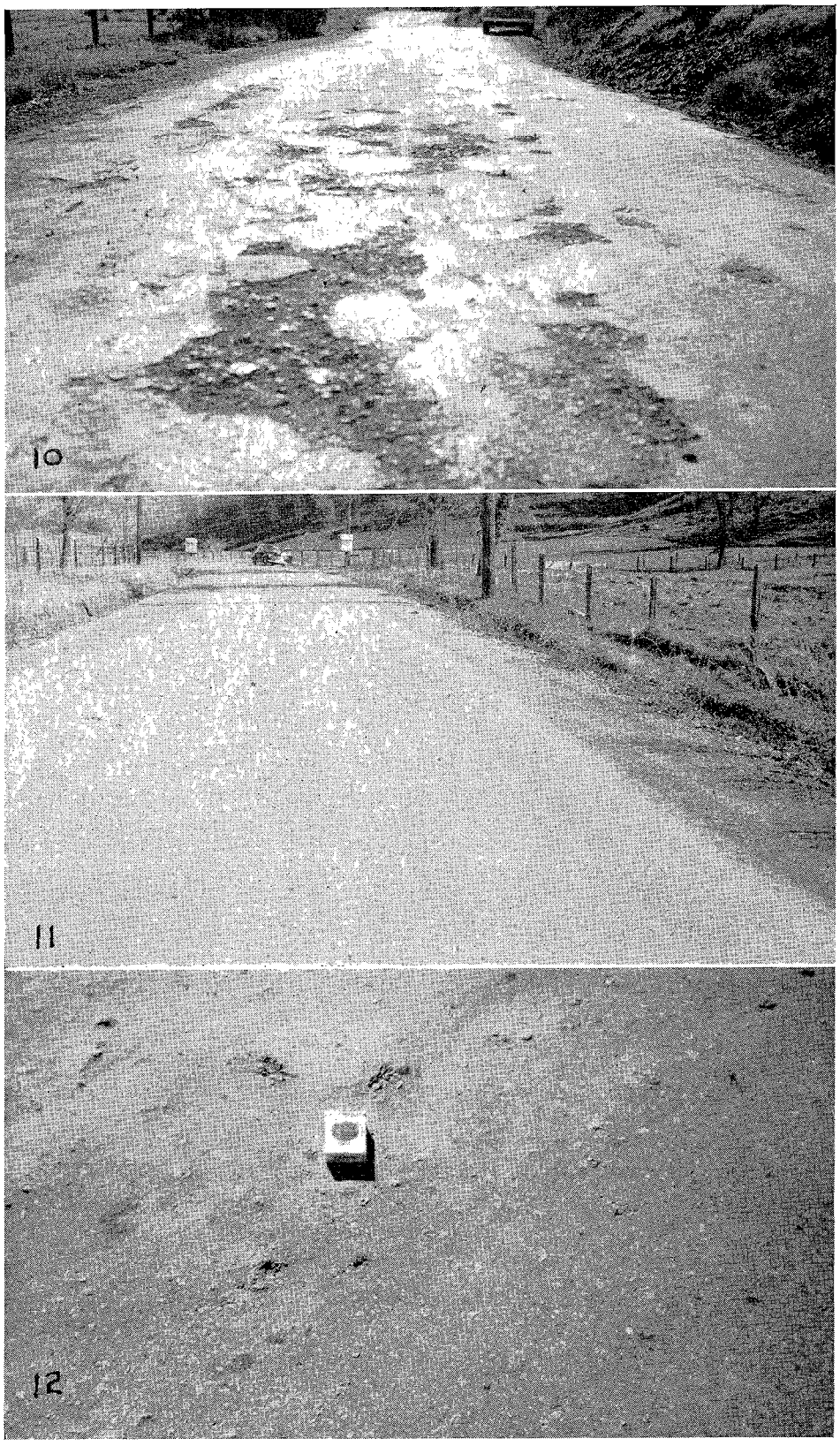
The second project comprised the construction of a test section which consisted of imported base material to which was added approximately 4 percent hydrated agricultural lime on Road III-ED-93-B between Cool and Georgetown. The work was started in November, 1948, but had to be discontinued due to inclement weather. The project was completed in the spring of 1949.

The old surfacing over the entire section consisted of penetration treatments or road-mixed blankets which were placed at various times since the road had been taken into the State Highway System in 1933.

Portions of the section had become very badly distorted and disintegrated and it became apparent that it would be impossible to maintain the section within the realm of routine maintenance and therefore remedial measures were required to correct the existing conditions in order to carry the increasingly heavy traffic.

Weakened Base Restored

It was proposed to restore and recondition the weakened base at various locations, the areas ranging from 16 feet to 18 feet in width and from 100 feet to 2,400 feet in length, with a local crushed limestone, treated with agricultural hydrated lime and to apply a penetration treatment over the areas thus repaired.



***10**—Failed section which was not treated with lime. This section was in satisfactory condition in October, 1948, but failed during the following winter. **11**—Appearance in March, 1950. (Compare this with photo No. 7.) **12**—Closeup of same section (compare with photo No. 8).*

The imported borrow material consisted of a waste crushed limestone mixed with some overburden and was obtained from the California Rock and Gravel Company (Crego Plant) near Cool.

Preliminary laboratory tests indicated that the material would be satisfactory for use as base rock with the exception of the Plasticity Index (P. I.) which showed a value of 9. The California Bearing Ratio was 100+ at 0.1 inch and 0.5 inch penetration, and the expansion was 0.4 percent. In order to reduce the P. I., tests were made adding small percentages of cement and agricultural lime to the material and the resulting tests showed that the material was rendered nonplastic by the addition of 4 percent of cement or lime. As the agricultural lime could be obtained at a very reasonable cost from the Diamond Springs Lime Company near Placerville, it was decided to use the rock base material with the addition of 4 percent lime.

Day Labor Project

A day labor allotment in the amount of $20,000 was issued to cover the cost of the work. This was sufficient to place about 6,700 tons of treated base material. The first unit undertaken in November, 1948, consisted of 11 portions, ranging from 150 feet to 2,400 feet in length and requiring a total of approximately 4,500 tons of base material with 3,700 tons actually placed during November, 1948. Sections 12 and 13 were constructed during 1949. On most of these portions the base material was placed directly in two courses, each 3 inches thick, upon the old surfacing. In a few cases, the existing thin surfacing and base was scarified, then recompacted, and only 3 inches of new base material was placed. *Table III* shows the thickness placed and the condition of the first 11 sections as of April, 1949.

Nature of Work

In general the work consisted of spreading base material sufficient for a 3-inch thickness and 18-foot width by means of a spreader box on one-half width of the roadway. The lime, which was hauled in bulk by truck from Diamond Springs, a haul of approximately 22 miles, was spread by means of a Buckeye spreader box. The lime was rather damp, showing a moisture content ranging from 25 to 40 percent. Including the moisture content the percent of damp lime added ranged from 5.0 to 5.5 percent by weight. The mixture was then bladed into a windrow along the edge of the pavement until ready for mixing which was usually started the following day, or as soon as time permitted. The mixing was accomplished with the aid of a pulvomixer and a motor patrol and four to six passes were generally sufficient to thoroughly mix the materials. It was then laid out with the blade and compacted with a roller. A water truck was on hand for sprinkling if it appeared necessary. The second course was laid in a similar manner. A penetration treatment of one-fourth gallon per square yard of SC-3 oil was then applied to four sections and covered with fine material obtained from the same stockpile as the base rock. Due to inclement weather the oil treatment for the other seven sections was not applied until the spring of 1949.

The daily traffic observed during construction operations consisted principally of passenger cars, a few pickups, and perhaps about 20 heavily loaded lumber trucks. The right half (easterly side) only of the road is subjected to the loaded lumber trucks which return empty on the opposite side.

TABLE III

III-Ed-93-B

Section number	Length, feet	Location distance miles from Cool	Thickness of base as placed with surface treatment as of April, 1949	
		0.00	Maintenance sign at junction routes 93 and 65 at Cool	
11	2,450	2.60	3" base placed November, 1948, no oil treatment	
			3" base to be placed May, 1949	
10	516	3.38	6" base	No oil treatment
9	350	3.53	3" base	No oil treatment
8	200	4.15	6" base	Penetration oil treatment, 1948
7	150		3" base (One continous section)	Penetration oil treatment, 1948
6	600		6" base	Penetration oil treatment, 1948
5	600	4.65	6" base	Penetration oil treatment, 1948
4	280	5.35	6" base	No oil treatment
3	200	5.59	6" base	No oil treatment
2	600	5.75	6" base	No oil treatment
1	400	6.60	6" base	No oil treatment
			(All oil treatments were completed in May 1949)	

Cost Comparison

Due to the numerous short sections, 11 in all, which required frequent turning of the equipment, the narrowness of the road, nonavailability of a detour, delays due to inclement weather, etc., it is rather difficult to present an accurate cost comparison; therefore, no detailed cost records of the individual operations were kept on the job. According to Maintenance Superintendent E. Willis of Placerville, the total cost of placing the rock base in November, 1948, including the lime but exclusive of oiling operation, amounted to $2.56 per ton. However, by making certain assumptions the cost of the lime stabilization can be fairly accurately estimated. This extra expense involves the cost of the lime, hauling, spreading and mixing operations.

Cost of lime at Diamond Springs (wet)	$3.50
Sales tax at 2½ percent	0.09
Haul 22 miles at $0.10	2.20
Cost of lime at job per ton (wet weight)	$5.79

Assuming an average moisture content of 30 percent for the lime, the cost per ton of dry lime is:

Cost per ton dry lime FOB Placerville $3.50 x 1.30 =	$4.55
Cost per ton dry lime at job $5.79 x 1.30 =	$7.52
Cost per ton of untreated rock delivered to job site was approximately	$1.54
Cost of lime per ton of aggregate (0.04) (7.52) =	$0.30
Cost of spreading and mixing the lime per ton of aggregate was estimated to cost	$0.25
Total cost of the lime treatment per ton of aggregate was equal to 0.30 plus 0.25 =	$0.55

from $3.50 to $4.50 per barrel in Placerville, a price of $1 per sack is assumed and assuming a cement content of 2½ percent the cost of the cement per ton of aggregate would be:

$$\frac{(2{,}000)\ (0.025)\ (\$1)}{94} = 53.2¢, \text{ say } \$0.53$$

The cost of 4 percent of dry lime per ton of aggregate is:

$$(0.04) \times (\$4.55) = 18.2¢, \text{ say } \$0.18$$

On the basis of the above comparison, the saving amounts to about ($0.53 — $0.18) or $0.35 per ton in favor of the waste agricultural lime.

a few loads of rock. By visual inspection this material appeared inferior and the use of material from this portion of the stockpile was discontinued. In general, the untreated base material appeared to be of fair to good quality. Tests made shortly after the addition of 4 percent lime (dry weight) showed a lower P. I. or nonplastic material. The four samples obtained in April, 1949, had a plasticity index of zero.

Base Course

The base course, either 3 inches or 6 inches thick (in most cases even without any bituminous surface treatment), has stood up satisfactorily during the winter of 1948-49 which was considered one of the wettest. The inspection trip in April, 1949, revealed that the base had hardened considerably and some effort was required to dig holes for test samples, especially in Section 2 in which it was difficult to sink the pick into the pavement. Section 11, which had gone through the winter with only 3 inches of base material and no protective oil treatment, showed some raveling. In Sections 5, 6, 7 and 8 which were completely

. . . Continued on page 56

TABLE IV

PRELIMINARY SAMPLES

III-ED-93-B

Date sampled	Test number: U No.	Test number: Aggr. Dept. No.	Test number: Dist. No.	Treatment	Grading % Pass: ¾	Grading % Pass: #4	Grading % Pass: 200	Grading % Pass: 5u	Grading % Pass: 1u	C.B.R.: 0.1″	C.B.R.: 0.5″	PI	R Val.	Den. wt. cu. ft.	Thickness reg.	Remarks
July, 1948		48-3070	R-1-E	None	79	46	21	5	2	131	136	9				
	404	A		2% cement						497	287	9	80-90	137	0	
		B		4% cement						767	473	NP				
	404A	C		2% lime						218	192	8	77	136	3.5″	
		D		4% lime						397	265	NP				
		E		3% cement								7				
		F		3% lime								6				
	405	48-3071	R-2-E			100	21									Agricultural lime used in test 3070
Oct., 1948	524	48-4474	R-2-E	None	79	43	17	6	3			7	76	140	4″	
	524A			4% lime									82	132	2	
	525	48-4475	R-3-E	None	80	43	17	6	3			7	77	138	3.5	
	A			4% lime									82	133	2	Lime U 530
	B			2% cement									95	135	0	
	C			4% lime									89	134	1	Lime U 531
	526	48-4476	R-4-E	None	92	52	20	5	2			NP	87	138	1	
	A			4% lime									87	132	1	Lime U 530
	530	48-4496	R-5-E			100	39									Stockpile lime
	531	48-4497	R-6-E			100	85									Bagged lime

The only two ingredients for reducing the P. I. or increasing the R Value of the base material that would have been considered for this job were lime or Portland cement. Generally speaking, the only difference in cost is the initial cost of the material, as the cost of hauling, mixing, spreading and compacting would be approximately the same for both materials.

From previous experience on similar jobs about 1½ percent to 2½ percent of cement is usually sufficient to achieve these results.

With the price of cement ranging

Conclusion

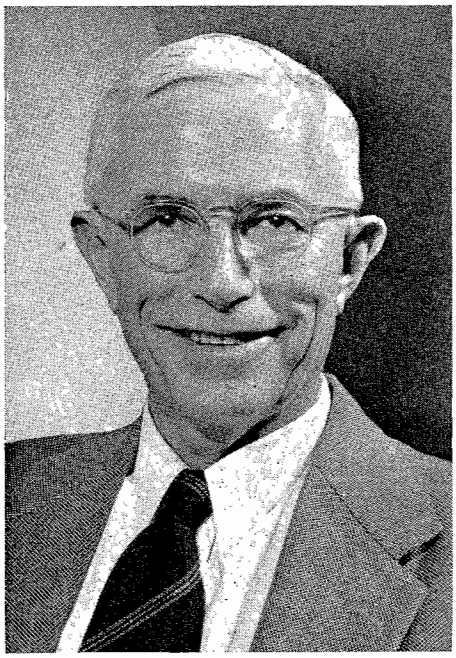
Preliminary samples submitted prior to start of construction showed a California Bearing Ratio in excess of 100, however, plasticity index test results ranged from 7 to 9. Laboratory tests indicated that the addition of 4 percent of agricultural lime would render the material nonplastic. Samples of the untreated rock base taken during actual construction showed a P. I. of 7 and an "R" Value of 77 to 79. Sample No. U 615 (*Table V*) which showed a Plasticity Index of 16, represents only

Another Loss

E. Q. Sullivan Joins List of Veteran Highway Engineers in Retirement

CHALK UP another loss to the Division of Highways.

E. Q. Sullivan, District Engineer at San Bernardino, joined the growing ranks of veteran state highway engineers in retirement on August 3d after 36 years of distinguished service. He had served for 27 years as District Engineer of VIII, embracing San Bernardino County and the western portion of Riverside County. During that period he directed highway construction costing $75,000,000.



E. Q. Sullivan—1950

Mr. Sullivan was requested to tell in his own words something about himself and his public career as a highway engineer. Here is his interesting narrative:

Born in San Diego

"I was born in 1887 in San Diego and went to San Diego High School, completing high school in 1907. I worked my way through high school carrying two paper routes in San Diego; one route on the San Diego *Union* and one on the San Diego *Tribune*. I also had a job winding the San Diego town clock at $1 per week. The clock was in the courthouse tower and was run by a heavy weight (about 500 lbs.) that had to be cranked up with a hand wrench. I also had a job as "organ pumper" at the First Congregational Church of San Diego at 25 cents per church service.

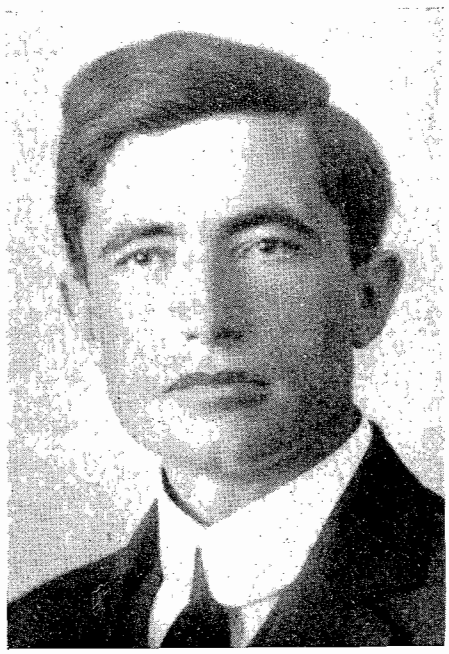
In the summer of 1907 I went to work on the Santa Fe Railroad working out of San Bernardino as "stake puncher" on a survey party. I planned to go on to the University of California, but I had to work my way through and, therefore, stayed out one year, remaining with the Santa Fe until August, 1908. During this year on the Santa Fe, I progressed from stake puncher to chief of a small survey party. The next summer school vacation I went back to work on the Santa Fe Railroad and was assigned as inspector on construction work. I then returned to the university for another term but had to stay out between the sophomore and junior year for a year to earn enough money to go on through college. That year I worked on the Santa Fe on construction and relocation work. Most of the time I was inspector on construction work, but at times I was in charge of a survey party.

Graduates From U. C.

"Completing my education at the University of California in 1913, I was employed by a private engineer in Los Angeles (long since deceased). I did relatively little work for him, but he placed me on a number of projects that were designed in his office. I went out as construction superintendent to build these projects with day labor forces. One of these projects was the North Main Street Bridge in Riverside which supports a branch of the railroad over North Main Street. This bridge was written up in the *Engineering News Record* a few years ago, and the opinion was expressed that this was the first reinforced concrete bridge for railroad use built in the United States. The article in the *Engineering News Record* asked readers to send in known bridges of earlier date, but no response was received from the readers of the magazine. This bridge is still in place and in excellent condition; State Highway Route 43 passes under it.

Goes to Hollywood

"In the late fall of 1913, I went to work for "Paramount Pictures" which was organized at that time. I acted as their construction superintendent and had daily conferences with the operating heads of Paramount. We conferred for perhaps an hour every day



E. Q. Sullivan—1914

at the studios we were constructing. The operating heads were the well-known Los Angeles capitalist Gabert, the famous actor Bosworth, and Jack London, all now deceased. I grew to know these fine men very well during this period and they did not want me to leave when I went to work for the State the next summer.

"I believe I took the first civil service examination given; it was in the fall of 1913 or spring of 1914. I passed this examination and was offered a job and accepted at about half the pay I was receiving from Paramount. Jim Standley, now Assistant State Highway En-

gineer, also took the same examination and was appointed from the same list. We both went north on the same train, though we did not meet on the train or know each other at that time. We met for the first time when we reported in Dunsmuir on August 3, 1914. I was assigned as assistant resident engineer under Spencer Lowden, who had received an appointment about a year earlier. Spencer had a good previous background of experience as assistant county engineer of one of the northern counties (I believe Shasta County). I was assistant resident engineer to Spencer for about three months and then was appointed resident engineer and was transferred to Tehama County.

"On September 18, 1916, I was married to Rosalind J. Chase. Rosalind and I were in school together from kindergarten through high school. She went on to Occidental College and I went to the University of California, but she took postgraduate work at U. C. in Berkeley during my last year in college. Our honeymoon consisted of a motorcycle trip from Red Bluff to San Diego. It took five days each way in those days to make such a trip. The roads were still mostly dirt roads and motorcycle traveling was not easy. We have two children; Edwin F. Sullivan, who is an engineer in the Reclamation Service, residing in Sacramento, and Jean R. Sullivan, who is Director of Admissions at International House at the University of California, Berkeley. Jean is at present on one year's leave of absence in Europe.

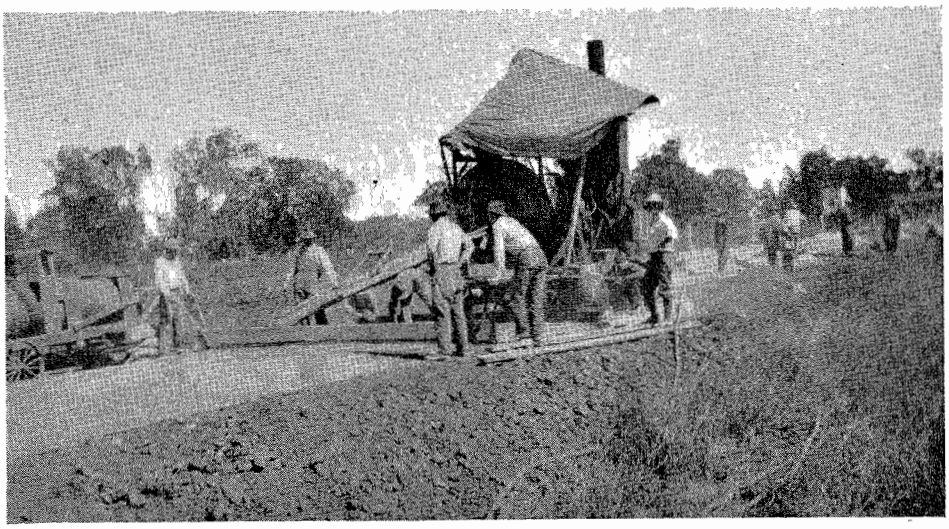
"I stayed in Tehama County for about nine years, being promoted finally to assistant division engineer. During this time, Russ Stalnaker, Jim Standley, Harry Comly and I held the active administrative jobs under Division Engineer T. A. Bedford, a fine person and wonderful leader. The field work was largely in the hands of Harry Comly and myself. I had the south end of the division and lived in Corning and Red Bluff. Standley and Stalnaker were in the Division Office.

No Autos for Engineers

"When I first went to work for the State, employees were not permitted to have automobiles in District II. Saddle horses were at first permitted for transportation, and horse and buggies were later provided for resident engineers. The State called for bids and livery stablemen would bid on furnishing a horse and buggy. I recall that I succeeded in obtaining a very beautiful pacer. This animal was reputed to be the fastest horse in Tehama County at that time and was raced every year at county fairs. The animal was a mare named Molly of beautiful chestnut color with a white star on her forehead. Between fairs, she was eating her head off in the stable and the owner of the stable was glad to rent her out to some one person rather than to a succession of "traveling men" who were the usual customers of the livery stable.

In going to work, the roads were dusty and no young engineer worth his salt desired to have anyone pass him on the road. I vividly recall that I quickly learned to take the reins up short, cluck to Molly when anyone tried to pass us, and down the road we would go pacing in a cloud of dust. Early in 1916 I was permitted to have a motorcycle which I had to buy with my own money; this was the motorcycle I used on my honeymoon in 1916. When the motorcycle was used on state business, the State allowed 1½ cents per

THIS PHOTO WILL INTEREST OLDTIMERS



The above picture taken in 1915 or 1916 in Tehama County shows one of the early paving operations with E. Q. Sullivan as resident engineer. The picture is panoramic in showing every detail of the operation.

Note that on the far, left-hand side there is a horse-drawn water wagon to supply the concrete mixer. On the left side the narrow 15-foot width of pavement clearly shows. It looks like one-lane, but it is really the old original two-lane, 15-foot wide Portland cement concrete pavement. The thickness was four inches and the mix was 1-2½-5.

Note next, the hand tamper with a man on each end. A "scratch template" can be seen just in front of the mixer. This was an invention that appeared simultaneously on many jobs. Mr. Sullivan recalls that he put one on the first job he was on as resident engineer to the dismay and surprise of the contractor. The "scratch template" measures the thickness of the concrete pavement by scratching along the subgrade and this equipment was, of course, required on all later contracts. Note the mixer is a steam-engine mixer with a boiler; a real antique.

"I recall," says Mr. Sullivan, "on this particular rig that I insisted that the canvas canopy be placed by the contractor. He was unable to keep a mixer operator on the mixer long enough to learn the job because each one collapsed with the heat. The location was in Tehama County and the time was midsummer with temperatures well over 100 degrees. The operator stood with his back to the boiler under the glaring sun.

"I am seen standing just slightly to the right of the boiler of the concrete mixer. Beyond me and along the subgrade are seen the laborers loading wheelbarrows with gravel and sand which they ran over the subgrade and dumped into the skip of the mixer. The mixer skip is hidden behind the boiler of the mixer."

mile reimbursement, but I had to furnish the gas, oil, repairs, and tires. Tires were the principal cost since they only lasted one or two thousand miles.

His Banked Curves

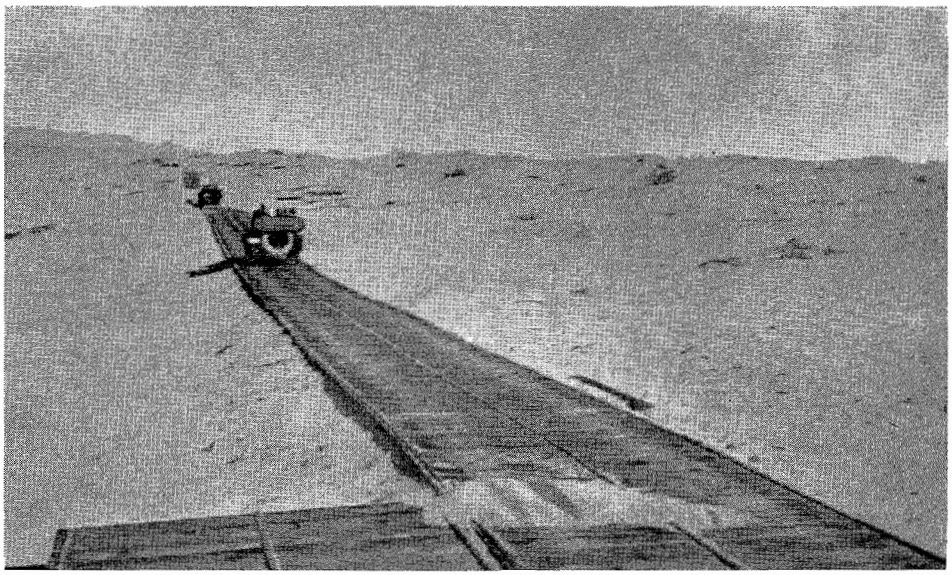
"In the early days, the pavements were 15 feet wide, four inches thick, and 1-2½-5 mix. Superelevation of curves was not permitted (banking of curves). I recall that on an early job on which I was resident engineer I went ahead and banked all the curves without obtaining my authority from the division engineer or from the Sacramento office. The chief engineer was then A. B. Fletcher. County ordinances usually limited the speed of traffic to 25 miles per hour, and this was the case in Tehama County at that time; so, banking of curves was really hardly necessary.

"After the job was finished a big celebration was held and officials came from Sacramento, including the Governor. I was very proud of my banked curves as I had received a good deal of favorable comment from the local people. They were just like the railroad curves with which I had been familiar in my earlier railroad experience. I recall, however, an extremely sharp reprimand, both from the division engineer and the chief engineer, who came to the celebration. I was asked to explain in a formal letter by what authority I had superelevated the curves. It was a tough letter to write to "Headquarters." I remember that I hoped they would fire me; I would then have gone back to Paramount at greatly increased pay. However, nothing came of it. The following year all new contracts provided for banked curves.

New District Created

"In coming to San Bernardino as district engineer on October 1, 1923, I was told by the new chief engineer, R. M. Morton, that the object in creating San Bernardino District VIII was to relieve Los Angeles District VII of the burden of locating and constructing the interstate connections to Southern California. At that time U. S. 66, U. S. 60, and U. S. 80 were the three interstate connections. (U. S. 91 had not then been added to the State Highway System.)

"There were no accurate maps of the vast desert region between Las Vegas and Yuma, and my first years as district engineer were spent in intensive study of routing locations for these interstate connections. The existing roads were practically impassable. The only road that carried any appreciable amount of traffic was Highway 66. This road was two ruts in the sand; where the ground was hard, it was two rows of chuck holes. It required 2½ days to go from San Bernardino to Needles, a distance of 240 miles.



This is old plank road across sand dunes near Yuma to which Mr. Sullivan refers in his article

Road Through Sand Dunes

"A plank road eight feet wide had been built across the sand dunes near Yuma on Highway U. S. 80, but I was instructed to try to find a better solution since this plank road had already grown to be wholly inadequate even for the slight traffic of 1923. The plank road was designed to be raised or lowered to conform to the shifting sand. The maintenance cost was extremely excessive.

"This design was a standard design throughout the world for similar conditions; no attempt had ever previously been made to build a road on permanent line and grade across moving sand dunes. The solution to the problem was found after two years of research. The research consisted of construction of a wind tunnel and a thorough, experimental study of the behavior of moving sand. At the same time, field studies were undertaken and careful observations and measurements were recorded of the sand dune behavior on locations across the dunes. The solution to the problem was a combination of proper alignment relative to prevailing wind direction plus profile elevation relative to height of moving dunes. At that time, there was no literature on this subject, and, for many years, engineers from all over the world visited District VIII to observe this road and to consult on similar problems in their countries. Engineers came from Egypt, Australia, Chile, Peru, and South Africa.

High Cost of Old Road

"Before the construction of the highway on permanent alignment and grade across the sand dunes, the cost of raising and lowering the old plank road had reached $35,000 per year, which was a prohibitive cost for those days. Freedom from sand trouble on the new road saved its entire cost of construction in less than 11 years in addition to giving highway traffic a two-lane pavement on modern standards.

"All of the interstate connections across the desert have long since been located and constructed on modern standards of safe high speed alignment and grade. These desert connections consist of about 800 miles of desert roads from Southern California to Las Vegas, to Needles, to Blythe, and to Yuma.

"I have been district engineer in District VIII ever since 1923. San Bernardino District Headquarters is in the populous metropolitan area only 57 miles from the center of Los Angeles City. The district boundary is half-way between the center of Los Angeles City and the center of the City of San Bernardino so that the problems of District VIII have also included heavy metropolitan traffic out of Los Angeles, as well as the long desert routes. Recent

. . . Continued on page 57

Hollywood Freeway

By FRANK B. CRESSY
Assistant District Engineer—Construction

THE HOLLYWOOD FREEWAY is often considered as the most important freeway in the Metropolitan Los Angeles Freeway System. It is 10 miles long, extending from Spring Street in the Los Angeles Civic Center northerly to Vineland Avenue in the San Fernando Valley. The 1½-mile unit from Highland Avenue to Barham Boulevard, then known as Cahuenga Freeway, was completed in 1939 under a Los Angeles city contract, financed with city, federal and state highway funds. Further construction on this important freeway was delayed until additional state funds could be provided, as was done by the Collier-Burns Highway Act of 1947.

With additional financing made available, most of the required right of way has been acquired and cleared, and considerable construction has been completed or is now in progress under state contracts on the Hollywood Freeway. The two-mile section extending from the Cahuenga Freeway northerly between Barham Boulevard and Vineland Avenue was completed two years ago at a cost of $1,500,000. This section included the grade separation bridge to carry the freeway over Lankershim Boulevard.

Four-level Structure

Also completed about two years ago is the unique four-level grade separation structure at the junction point of the Hollywood Freeway with the Harbor Freeway and the Arroyo Seco Freeway. The arrangement at this grade separation structure is such that four separate roadway levels pass or cross one another in a single bridge structure. This results in economy of construction costs. In order to function as a freeway traffic interchange system, the four-level grade separation structure requires in close vicinity what might be called 12 "satellite" bridges.

... Continued on page 18

By H. E. BELFORD
Resident Engineer

CONSTRUCTION on the Hollywood Freeway between Glendale Boulevard and Virgil Avenue, a distance of 1.6 miles, was started on June 22, 1949, by the N. M. Ball Sons Company, contractors, and is approximately 80 percent complete.

The work consists of grading and constructing an eight-lane concrete divided highway, separated by a 10-foot central dividing strip, construction of various off and on ramps, outer highways and city street connections, installation of storm drains and sanitary sewers, construction of a reinforced concrete box-section pedestrian undercrossing and various retaining walls, installation of a complete sprinkling system for the entire project, and fencing of the right of way.

Grading operations are now complete excepting for minor cleanup, a total of 500,000 cubic yards of earth having been moved, of which approximately 335,000 cubic yards was waste material which was hauled to the state-owned disposal area along Bishops Road, and the balance used for roadway embankment construction. Wherever possible on the project, excavation and embankment slopes were flattened to 2:1 or better in order to provide for easy planting maintenance.

Heavy Excavation

Construction of the eight lanes of Portland cement concrete pavement 12 feet wide and 8 inches thick, consisting of 18,600 cubic yards of Class "B" concrete, is 100 percent complete. Installation of sanitary sewers, storm drain pipes, storm drain structures, retaining walls and the pedestrian underpass are approximately 95 percent complete at this time.

This work involved 32,000 cubic yards of structure excavation, 2,680 cubic yards of Class "A" structure

... Continued on page 19

By HAIG AYANIAN
Resident Engineer

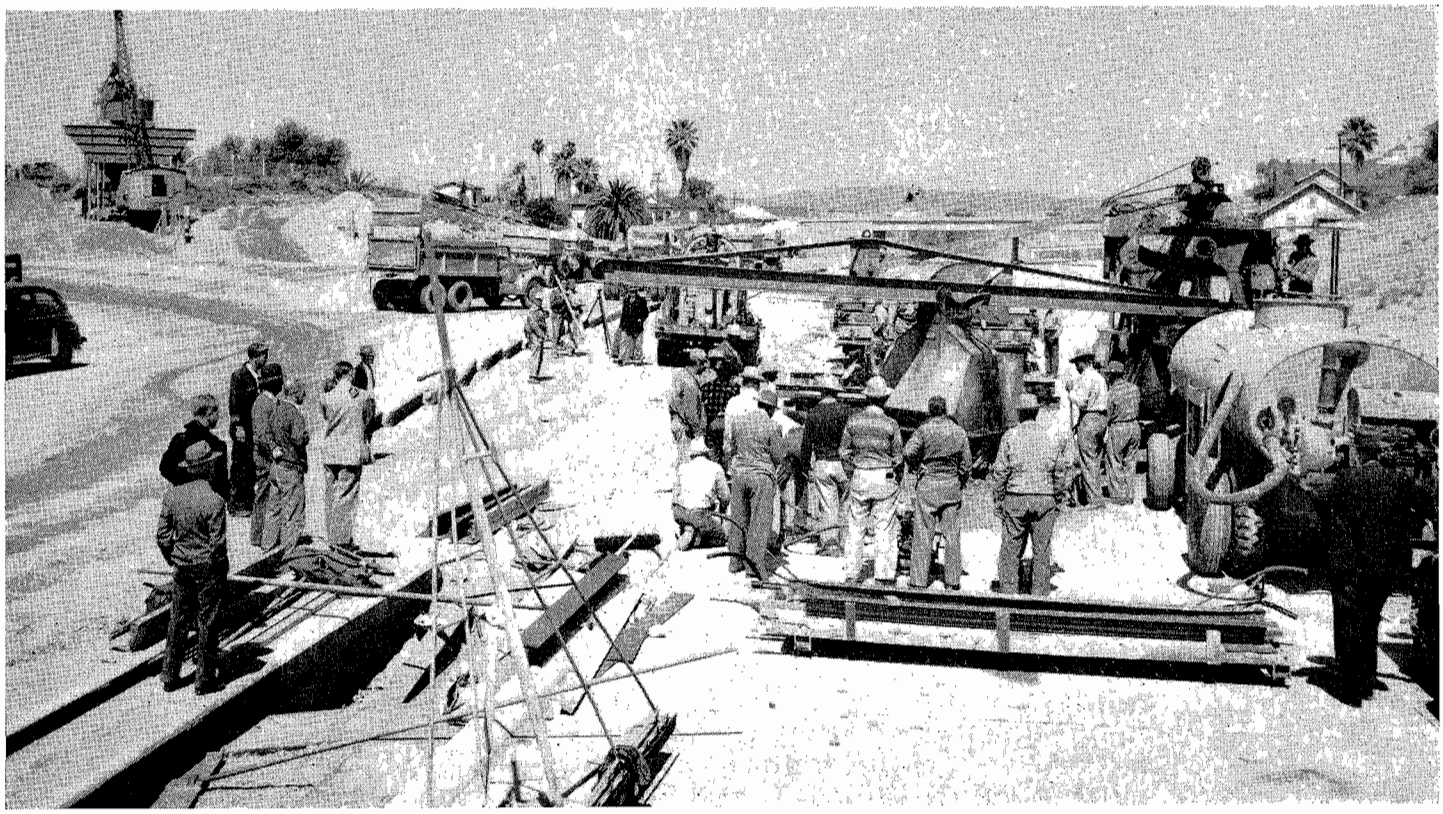
THE ROUTE of the Hollywood Freeway, Road VII-LA-2-LA, from Grand Avenue to Glendale Boulevard, 1.6 miles in length, passes through a densely built-up residential district and across many important city streets. The construction, now in the final stages, connects previously constructed grade separation bridges including the unique four-level structure at the junction of the Hollywood, Harbor and Arroyo Seco Freeways. Considerable work is being done on the various interchange ramps surrounding and leading to this structure. The construction was started on July 12, 1949, by N. M. Ball Sons, the contractor.

At the present time this contract is approximately 70 percent completed. The concrete paving and cement treated base operations are now in progress and are moving along at a rapid rate toward completion. All the underground facilities and installations have been completed as has the roadway excavation. Eight 12-foot wide Portland cement concrete traffic lanes have been completed from the four-level structure westerly. It is anticipated that the contract will be completed by the end of 1950 and well within the specified time limit. The estimated cost of this project is about $996,000 exclusive of engineering.

Design of Freeway

The design of the freeway provides for four lanes on each side of the 10-foot wide division island from the west to Beaudry Avenue Undercrossing, at which point the Hollywood Parkway is reduced to six lanes divided. It has two additional lanes on each side, diverging to form the interchange ramps at the four-level structure. The complex system of interchange ramps is in general composed of two-lane road-

... Continued on page 20



On May 4, 1950, the first concrete was poured for the pavement at westerly abutment of Glendale Boulevard grade separation

Continued from page 17 . . .

Including the cost of these bridges, the cost of right of way and the cost of construction, completed or in progress, the four-level interchange system represents an investment of $5,000,000. Grade separation interchange systems as costly as this are justified only where large volumes of traffic must be provided with easy interchange between freeways.

Grade Separations

Between the Los Angeles Civic Center and Western Avenue, the completed construction now includes 22 grade separation projects, and there are three grade separation bridges on which work is in progress. From Western Avenue to Highland Avenue, grade separation construction is now under way at Sunset Boulevard, Wilton Place and Fountain Avenue, and right of way acquisition and clearing is approaching completion. From Western Avenue into the Los Angeles Civic Center, four contracts are now under way for grading and paving. The Civic Center grading contract was described in a previous issue of *California Highways and Public Works* (May-June 1949 issue). The grading and paving contract for 1.7 miles of the Hollywood Freeway from Western Avenue to Virgil Avenue was awarded May 11th to the Griffith Company, and construction on this unit is off to a good start.

Exceptional progress is being made by N. M. Ball Sons, the contractor on two adjoining units of the Hollywood Freeway, totaling 3.6 miles in length. On the first of these units, from Grand Avenue to Glendale Boulevard, Mr. Haig Ayanian is the resident engineer. On the second unit, from Glendale Boulevard to Virgil Avenue, Mr. H. E. Belford is the resident engineer. In this same issue of *California Highways and Public Works*, progress reports on these two contracts have been made by the resident engineers.

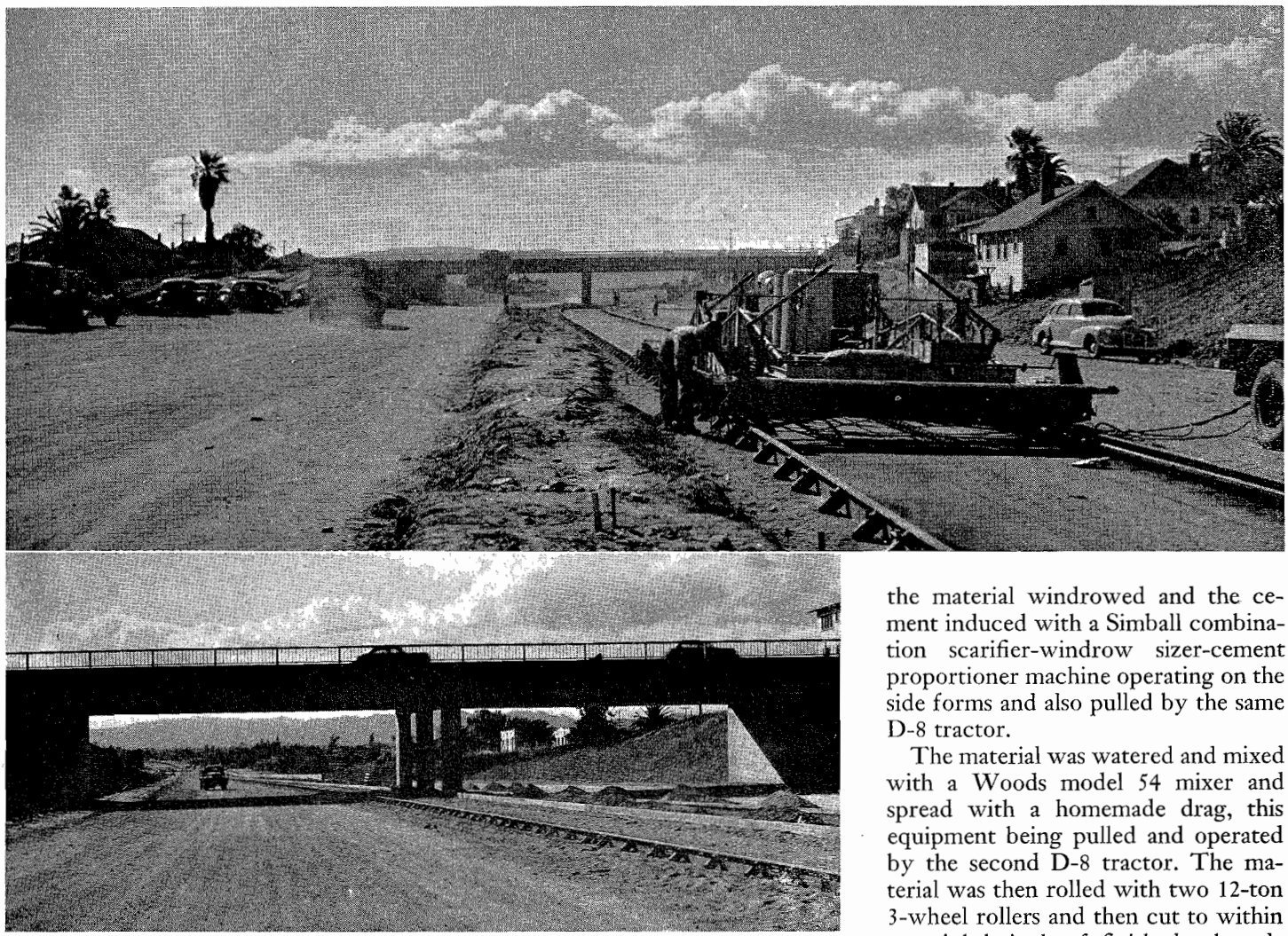
Many Economies Effected

Because of the fact that the same contractor was low bidder and was awarded the contracts for these two adjoining units of construction on the Hollywood Freeway, many economies of operation have been worked out and much better progress toward completion has been made than if the work had been handled by different contractors. The grading work, the cement treated base construction and the paving operations were carried out as if these two units were one contract. The identity of these two units has become a matter of bookkeeping only, since the same construction crew and the same engineering supervision force are being used for carrying out these operations without regard for the line of demarcation between the two contracts. As of this date, all eight lanes of the main freeway pavement have been completed on both contracts between the four-level grade separation structure and Virgil Avenue.

First Concrete Poured

On these two construction contracts, May 4th was a historic date. On that day the first bucket of Portland cement concrete was placed in the pavement at the westerly abutment of the Glendale Boulevard grade separation bridge, with the concrete paving operations proceeding in a westerly direction. The dramatic moment when the first bucket of concrete spilled onto the subgrade was pictorially recorded by a photographer of the Los An-

. . . *Continued on page 45*



UPPER—Looking westerly along the Hollywood Freeway with the Bonnie Brae Overcrossing in background. LOWER—Looking westerly along the Hollywood Freeway under the Benton Way Overcrossing

Continued from page 17 . . .

concrete, installation of 11,630 linear feet of concrete pipes of various sizes up to 60 inches, and the laying of 3,390 linear feet of sanitary sewers. Construction of PCC curbs, rolled gutters and miscellaneous sidewalk is in progress and approximately 60 percent complete.

Sixty thousand tons of imported subbase material have been hauled in from the state stockpile on the Bishops Road disposal area and placed on the roadbed, ramps and outer highways, in varying depths of 1.0 to 1.33 feet. About 70,000 tons of decomposed granite imported base material have been hauled in from the Hollingsworth Pit in the Griffith Park area along the Los Angeles River and placed in the imported subbase material to a compacted thickness of 8 inches.

Pavement Design

The top 4 inches of the imported base material under the 8-inch Portland cement concrete pavement on the main freeway was cement treated with 3.5 percent cement, and tests on this material show compressive strengths in seven days varying from 495 pounds to 896 pounds, and an average relative compaction of 98 percent.

The cement-treated subgrade for Portland cement concrete pavement was road-mixed beween the side forms. Pavement side forms were first set to line and grade and the subgrade cut to proper elevation with a Lewis subgrader pulled by a D-8 tractor, following which the subgrade was scarified to the proper depth for 4-inch treatment, the material windrowed and the cement induced with a Simball combination scarifier-windrow sizer-cement proportioner machine operating on the side forms and also pulled by the same D-8 tractor.

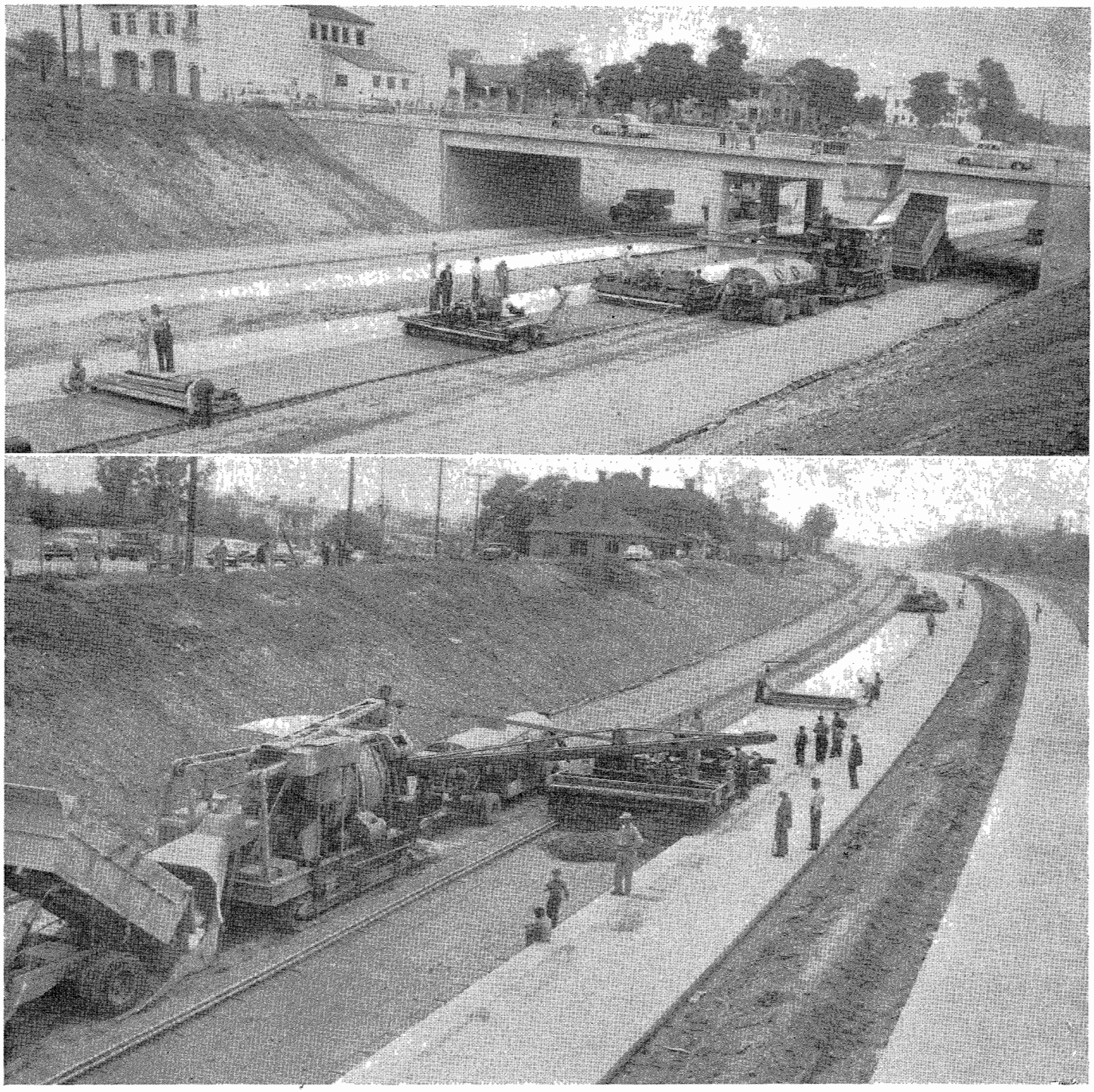
The material was watered and mixed with a Woods model 54 mixer and spread with a homemade drag, this equipment being pulled and operated by the second D-8 tractor. The material was then rolled with two 12-ton 3-wheel rollers and then cut to within one-eighth inch of finished subgrade elevation with another Lewis subgrader pulled by the No. 2 roller when making its last pass. A pneumatic-tired roller attached to the rear of a 500-gallon water truck was used for the final rolling, this truck furnishing any necessary water needed in order to secure a tight finish on the material.

Mixing type 60-70 emulsion was applied at the rate of 0.18 gallon per square yard direct from a small distributor truck for the cure seal. With the above equipment operating in a continuous train, the elapsed time between first scarifying the material and final rolling averaged 30 minutes, which was reflected in the high compaction and 7-day strength tests.

Will Be Completed in October

Pavement concrete was batched on the project and hauled by trucks to the mixer. A Koering 37E twin-batch

. . . Continued on page 53



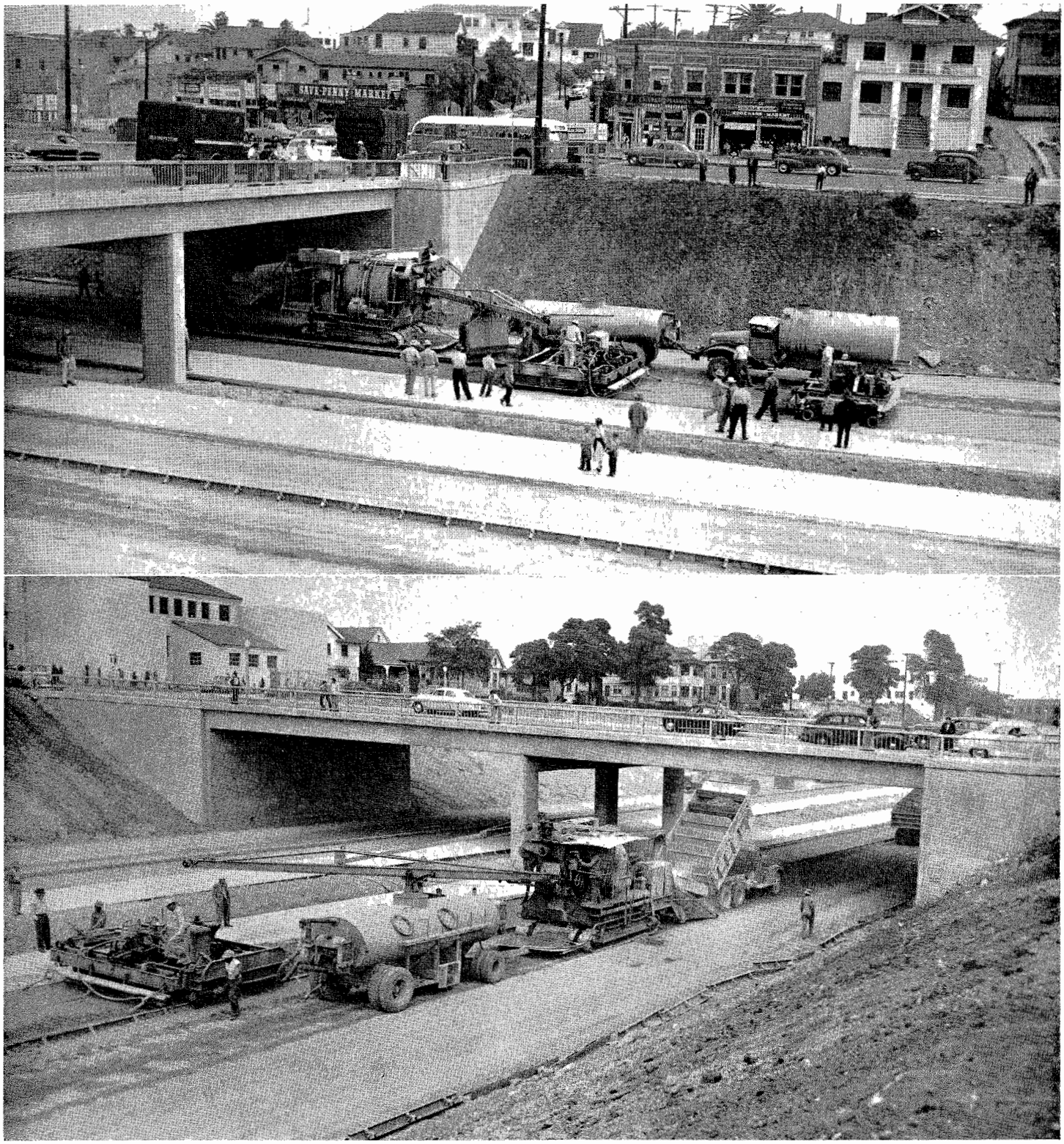
UPPER—Portland cement concrete paving operations at Edgeware Road Overcrossing. Looking east with fire station on left. LOWER—Portland cement concrete paving operations as viewed looking west from the Edgeware Road Overcrossing

Continued from page 17 . . .

ways. Acceleration and deceleration lanes are provided where needed.

In addition to work performed on the freeway proper, it is necessary to do extensive work on neighboring and abutting streets. Some of the lesser important streets are dead-ended at the freeway right of way. In one instance a pedestrian undercrossing was constructed. Grand Avenue presented a difficult problem due to the fact that it rose abruptly over the west side of Fort Moore Hill, between Temple Street and Sunset Boulevard. Inasmuch as entrance and exit ramps are to connect to Grand Avenue, it was necessary to lower the grade of this city street so that ramp grades would not be excessive.

The design called for placing of 8 inches of imported subbase material from a stockpile previously excavated from Fort Moore Hill under a prior



UPPER—Placing Portland cement concrete pavement on cement-treated subgrade. At Edgeware Road looking south toward Temple Street. LOWER—Portland cement concrete paving operations looking easterly at Edgeware Road Overcrossing

contract, and stockpiled at the Bishops Road Dump. An 8-inch layer of imported base material was placed over this subbase, and the top 4 inches of this material was cement-treated where Portland cement concrete pavement was to be placed. Acceleration and deceleration lanes consist of 4 inches of asphalt concrete pavement on 6 inches of cement-treated base, on 6 inches of imported base material under which there is 8 inches of the imported sub-

base material. Approximately 110,000 tons of these materials were hauled in from sources as far as nine miles away.

Traffic Cared For

Because of acute traffic conditions, the lowering of Grand Avenue was set up in the special provisions as the first order of work to be completed before any other work could be started, and public traffic was to be carried through the construction. During the morning and evening rush hours, a large volume of traffic moves over this street that is an important Los Angeles city traffic arterial. The maximum cut at the crest was approximately 16 feet and was made one-half width at a time. The underground work was extensive, requiring the construction of a new sanitary sewer system, new storm drain structures, changes in gas and water mains and telephone conduits. It was also necessary to build concrete retaining walls, stairways, and to adjust abutting properties to the new lower grade. The reconstructed street was surfaced with 8 inches of asphalt concrete. It is interesting to note that one of the old pavements uncovered and removed consisted of granite paving blocks set on an asphalt cushion. All the work of reconstruction of Grand Avenue has been completed.

Roadway Excavation

The roadway excavation on this contract, consisting of 290,000 cubic yards, was performed by conventional methods with heavy grading equipment. The only difficulty encountered by the contractor was the removal of massive concrete building foundations remaining after completion of right of way clearing operations. These were dozed out and broken up by means of an Emsco pavement breaker, and hauled to the state-owned disposal area at Bishops Road.

Most of the material excavated was a silty shale which offered no difficulty to being loaded and hauled by means of DW-10's, Tournapulls and carryall scrapers. The cuts were designed for cuts varying from 4 : 1 to 1½ : 1. The embankments were constructed by the usual methods, except a portion of the rolling which was done by a Caterpillar, DW-10, rubber-tired tractor unit converted so that the rear wheels consisted of the drums from a small sheepsfoot roller. This conversion was made on the job. Additional weight was placed over the rear axle so that the resulting load on each tamper foot was 265 psi. This roller was able to make almost three times as many trips per hour as the usual tractor-drawn roller, and the cost of this unit was considerably less than the conventional rig. The embankment slopes were designed for a minimum of 2 : 1, but in some areas where right of way was available, the slopes were flattened out to facilitate maintenance and to use as much of the excavated material as possible.

Seepage Overcome

A portion of the area around the four-level structure had been graded under the original bridge contract, and the area between this structure and Sunset Boulevard showed evidence of seepage in several locations. This was remedied by means of tile underdrains placed to intercept the seepage above the roadway and drain it into the storm drain system. When the trench was opened up under the Sunset Overcrossing a large flow of water was encountered. A 2½-inch pump just kept the water level constant for the first day, and then gradually drained the trench. The cut bank immediately north of the Sunset Overcrossing and lying across the end of the construction on the "A" line on this project, shows extensive seepage along its base. Temporary measures are being taken to lead these waters to the storm drains, and permanent remedial measures will be taken after this bank is removed, on a subsequent contract. The tile underdrains installed on this contract in this area are draining substantial amounts of water, and the roadbed has stabilized.

The existing and new cut slopes were scarified to a depth of six inches to provide for the future landscaping work. The contractor built a scarifier unit which was triangular in shape and had along its base the required scarifier teeth. This unit was fastened to a truck-mounted dragline in lieu of the drag bucket, with the apex of the triangle attached to the dragline cable. The unit was then hoisted to the top of the slope and pulled down, scarifying as it descended. The teeth were spaced closely enough so that the soil was well broken and aerated. The above unit was then modified so as to be placed on the bottom of a D-8 dozer blade. The scarifying was accomplished by running the dozer in reverse, thus not leaving tracks on the scarified areas. There are about 60,000 square yards to be scarified of which about 46,000 square yards have been completed.

Storm Drain System

A complete storm drain system was constructed and integrated with the Los Angeles City system. Approximately 7,000 lineal feet of storm drain pipes varying from 12 inches to 42 inches in diameter were placed along with some 300 cubic yards of Class "C" Portland cement concrete reinforcement. Existing sanitary sewer systems were remodeled and revised to fit the new construction. This work has been completed.

The pavement on the freeway proper and on the interchange ramps consists of an 8 inch Class "B" Portland cement concrete slab. The quantity involved is in the neighborhood of 22,000 cubic yards, of which at this time, more than one-half has been placed using the latest equipment and methods. Production has averaged over 850 cubic yards per eight-hour day. Due to the many bridges and structures to be crossed by the paving equipment, the contractor has evolved an efficient operation in moving. The lost time usually incurred in moving has been reduced to a minimum. The cement treatment preceding the paving operations has moved along very smoothly, as evidenced by the time interval of only one-half to three-quarters of an hour from the time the water is added until the final rolling takes place. Excellent results have been obtained so far as shown by relative compactions and compressive strength tests.

Erection of the 6-foot chain link fence along the right of way of the freeway has been started and is proceeding at this time. The contractor was forced to start his fencing operation earlier than usual in order to keep construction areas clear of privately owned automobiles parked for the

. . . Continued on page 23

NEW UNIT OF EAST SHORE FREEWAY IN OAKLAND OPENED

Motorcycle escort leads parade of official cars after dedication of latest unit of East Shore Freeway in Oakland. Hegenberger Road Overpass in background

At 11 a.m. on June 1st, Director of Public Works C. H. Purcell formally opened the latest completed unit of the East Shore Freeway, extending from 23d Avenue to 98th Avenue in Oakland, linking up that portion of the freeway from 23d Avenue to Sixth and Oak Streets.

The plans of the Division of Highways contemplate a freeway from Richmond in Contra Costa County to San Jose in Santa Clara County. The section from Richmond to the San Francisco-Oakland Bay Bridge has been in use for a number of years. The portion from 23d Avenue to Sixth and Oak Streets was opened a year ago.

The total cost of the 22-mile freeway is estimated at $64,000,000, of which 20 percent represents the cost of right of way. Dedication ceremonies held on June 1st under auspices of the Oakland Junior Chamber of Commerce, were staged at the Hegenberger Road Overpass.

Following the tape cutting, a caravan of cars in which rode state, county, and municipal officials, moved over the freeway to 23d Avenue.

Guests introduced at the brief ceremonies included George McCoy, State Highway Engineer; John H. Skeggs, Assistant State Highway Engineer for District IV; B. W. Booker, District Engineer for the State Highway Division; G. L. Beckwith, Director of Construction on the new freeway unit; L. A. Weymouth, District Engineer, and Jack Campbell, Maintenance Superintendent for the State Highway Division.

Others who attended the event included Claire V. Goodwin, President of the Oakland Board of Port Commissioners; William Sparling, new General Manager of the Oakland Chamber of Commerce, and a host of state and civic officials. Among them were Mayor Clifford Rishell of Oakland, City Manager John F. Hassler, Alameda County District Attorney J. Frank Coakley, State Senator Arthur H. Breed Jr., Assemblyman Luther H. (Abe) Lincoln, W. H. Park, President of the Oakland Chamber of Commerce, and city officials from throughout Alameda County.

E. R. Schmidt was chairman of the Junior Chamber Committee in charge of the event. Verne Wallace acted as master of ceremonies.

Director of Public Works C. H. Purcell assisted by Thomas E. Caldecott, Supervisor, 4th District, Alameda County, cuts ribbon to open new freeway to traffic

Hollywood

Continued from page 22 . . .

whole day. The proximity to the civic center of Los Angeles where parking space is hard to find and costly makes any unfenced areas attractive to motorists attempting to park their vehicles. This caused awkward situations to develop when it became necessary to perform work in an area covered by 50 or 60 automobiles. The situation is not to be relieved until the fencing has been erected around the construction areas.

State Fair

Thousands Will Travel State Highways to Attend Big Show

Motorists by the tens of thousands will use the superb highways of California to travel swiftly and safely to the California State Fair, to be held in Sacramento this year from August 31st through September 10th.

Burgeoning with stellar attractions and greater than ever, the 1950 fair, which is destined to top all previous state fairs, will hold an 11-day birthday party to celebrate California's 100th anniversary as a State.

Delivering of the State's charter 100 years ago will be reenacted as part of the opening day ceremonies on August 31st. State officials and Miss Hallie Hensley, of Marfa, Texas, a descendant of a member of the charter party, will be the principal figures in recreating this memorable event.

Birthday Theme

In keeping with the birthday theme, the fair is providing two great cakes. One, made of plaster and measuring 15 feet in diameter and 13 feet in height, will be located on the Mall and will be the scene of many festivities during the fair. It will be beautifully decorated with multicolored lights, pioneer figures and 100 great candles. In its interior will be a concealed music box.

The second cake, a tasty piece of pastry weighing 500 pounds, will be cut and distributed to fairgoers at a special birthday party at the Open Air Theater on September 9th, the anniversary of Admission Day.

Everything is being made shipshape, including the roads leading to the fair, for the hundreds of thousands of visitors, many of whom will motor to the state capital.

Nine state highways converge in Sacramento. These routes, radiating to the points of the compass, bring a constant flow of traffic to California's Capital from the several sections of the State.

Heterogeneous is the traffic traveling these routes; mammoth trucks, trailers and semitrailers, built to meet the varied demands of industry and commerce; grey busses, swift, slim and towering; medium-sized trucks and bob-tailed pickups of every description and carting every commodity; passenger cars of every make, model and vintage carrying salesmen, plumbers, mechanics, farmers, legislators, bankers and doctors, dowagers, sweet young things, and mothers with a car full of children. All these and many more make up the traffic flowing in all directions to and from Sacramento, the Capital City of California.

Nine State Routes to Capital

The nine state routes over which this traffic floods and ebbs include U. S. 40 to the west connecting Sacramento with the San Francisco Bay area and the west side of the Sacramento Valley, by way of U. S. 99W; U. S. 40 toward the east, the transcontinental highway which crosses the Sierra at historic Donner Summit; traffic from the east side of the Sacramento Valley uses this same entrance on U. S. 99E, joining with U. S. 40 at Roseville.

From the east also comes the flow of traffic on U. S. 50—the other transcontinental highway which enters California along the south shore of Lake Tahoe, climbs over the Sierra at Echo Summit and down to the valley via the American River Canyon and Placerville. To the south the principal state highway into Sacramento is U. S. 99, the central artery of the State Highway System, connecting the Capital City with the broad San Joaquin Valley, the vast metropolitan area of Los Angeles and the entire southern portion of California.

Roads Serve Large Area

Of less significance from the standpoint of traffic volume, but most important to the areas they serve, are the other five state highways which enter Sacramento.

From the delta lands on the east side of the Sacramento River, State Sign Route 24, on the levee, follows the river and carriers streams of vegetable produce from the rich delta soil to the packing plants, asparagus, spinach and tomatoes—each in its season. Similarly, State Highway 99 serves as the connecting link from Rio Vista and the delta lands on the west side of the river.

From the northwest quadrant State Sign Route 16-24 enters Sacramento over the I Street Bridge, having crossed from the westerly side of the Sacramento Valley to Woodland and along the west bank of the river.

The foothill country of the Mother Lode to the southeast is connected with Sacramento by the "Jackson Road," State Sign Route 16, which joins U. S. 50 at Perkins, just outside the city limits.

New American River Crossing

State Highway 98 is a route which originally was taken into the State Highway System primarily as a "bypass" of the city, connecting U. S. 40-99E at Fulton Avenue northeasterly of the city, entering on the "H" Street Bridge across the American River and again joining U. S. 99 at 14th Avenue in the southeasterly section of the city. However, this routing has been superseded by the route adopted crossing the American River near Elvas Junction, as mentioned in one of the following paragraphs, and statutory provisions prohibit the State from making any further capital expenditures on the original routing. Maintenance, of course, remains a function of the State until the newly adopted routing is constructed.

All of these state routes are paved highways, adequate for the traffic loads they are called upon to carry, ready to speed visitors to the State Fair or to the capital on business.

U. S. 40 from San Francisco to Sacramento is a four-lane expressway over all but 10 miles of its entire length and construction to four-lane divided

. . . Continued on page 55


FT. BRAGG
EUREKA
CRESCENT CITY
SAN FRANCISCO
SAN RAFAEL
VALLEJO
OAKLAND
SAN JOSE
PACIFIC GROVE
MONTEREY
RED BLUFF
WEED
REDDING
CHICO
MARYSVILLE
STOCKTON
WELCOME
GRASS VALLEY
ALTURAS
SAN LUIS OBISPO
MODESTO
SANTA BARBARA
FRESNO
SONORA
VENTURA
RENO
BRIDGEPORT
LOS ANGELES
BAKERSFIELD
PORTERVILLE
SAN BERNARDINO
SAN DIEGO
BARSTOW
PALM SPRINGS
EL CENTRO
ALVPINE
NEEDLES
CALIFORNIA
STATE
FAIR
at
SACRAMENTO
Via THE WORLD'S
FINEST HIGHWAYS
6

An Experiment

Prefabricated Steel Decking Used for Smoky Gulch Bridge

By W. B. PIPER, Assistant Bridge Engineer

RECENTLY a new type of bridge deck was used in the reconstruction of a bridge across Smoky Gulch in the desert area of Riverside County. The bridge is located about 7.4 miles east of Indio, on U. S. 60 and 70, which is one of the main highways going east from Los Angeles.

The existing bridge consisted of twelve 19-foot timber spans on timber pile bents with a laminated timber deck surfaced with asphalt. The deck structure had become badly deteriorated and the riding surface had become extremely rough, resulting in a high maintenance cost. In the face of its poor structural condition and inadequate roadway width, a new superstructure was an economic necessity. Inasmuch as the existing substructure of the bridge was in good condition, it was decided that it would be structurally feasible and economically desirable to utilize the existing substructure and replace only the deck system.

An Experiment

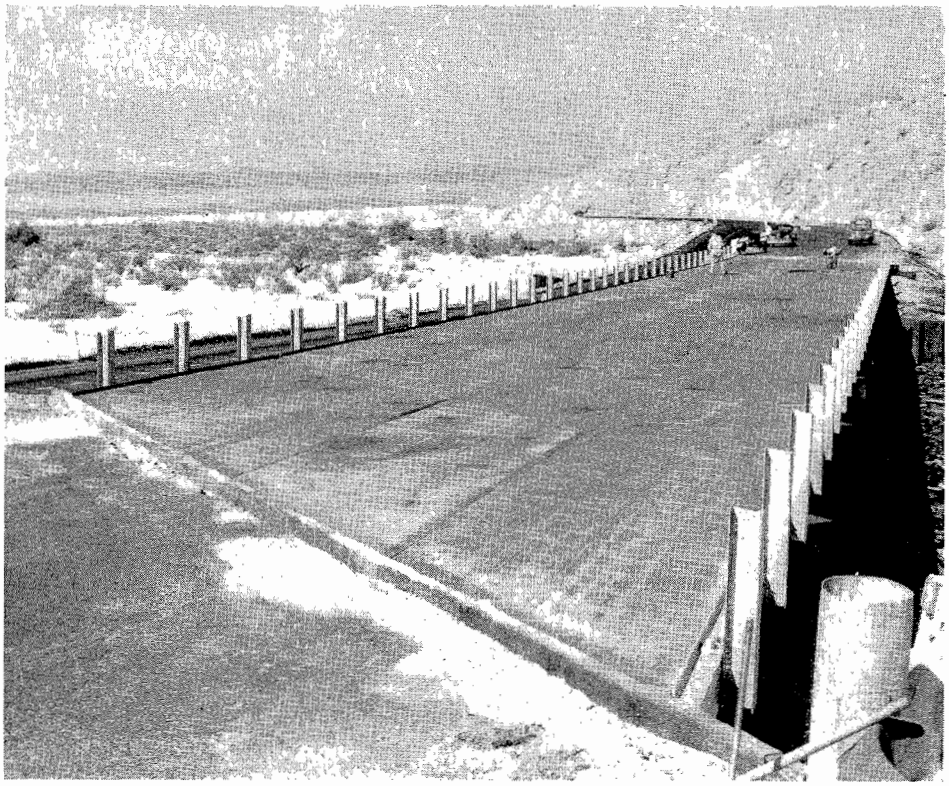
As an experiment, the Bridge Department decided to replace the conventional timber stringer and deck system with prefabricated steel panels. The original theory, as developed by the Bridge Department, was that:

(1) By using prefabricated panels the bridge would be out of service during redecking for a much shorter time than would result from other methods.

(2) That the initial cost would be favorably comparable to that of a concrete deck placed on timber stringers; and, furthermore, would present the possibility of full recovery of the deck structure and re-use in the event of relocation of the bridge.

(3) That redecking by this method could be utilized in a half-at-a-time operation, thus enabling a detour to be dispensed with; and

(4) That if it were necessary to build a detour the rapid progress of the replacement operation would enable the use of the detour to be cut to a minimum, thus making a saving in the quality of the detour required.



Nearly completed bridge ready for guard rail installation

Applicable to Other Bridges

This experiment was initiated in the hope that a feasible system of reconstruction could be developed which would be applicable to the many timber desert bridges which are near the end of their service lives and which will have to be reconstructed within the next few years.

The prefabricated deck was made entirely of structural steel and each unit was complete in itself and entirely independent of the other units. Thus the individual sections were fabricated so as to fit any place into the structure without the necessity of match-marking.

The panels consisted of a steel plate deck, I-beam stringers, and channels along the edges of the section, all welded into standard 7-foot x 19-foot panels. The floor plate was seven-sixteenths inch steel supported on two 10-inch intermediate I-beams with 10-inch channels along the edges of the panel. Four by one-quarter inch plate stiffeners were used at 15-inch centers. The units were entirely assembled in the shop and were welded throughout. The design of the panels will sustain an H-20 loading.

Heavy Truck Traffic

The Smoky Gulch Bridge lies near the foot of a long 6.3 percent grade, and carries a very heavy volume of traffic, a major portion of which is comprised of heavy trucks. These heavy trucks travel at extremely high speeds down the long grade and it was felt that in this particular location an attempt to reduce this fast moving traffic over a one-way bridge would be specially hazardous. Therefore, it was decided that the danger was too severe at this location to attempt to redeck the bridge one-half at a time and a detour was provided.

An economic study showed that at this location a detour could be built at a cost very little over that required to provide flagmen to control the traffic.

As soon as the detour was placed in operation the existing timber deck was removed from the pile bents and an additional cap was installed. Immediately thereafter the steel panels were placed upon the bents. The 48 units were placed in 2½ working days and two additional days were utilized in bolting the units together and installing the rail posts and metal guard rail.

Floor Panels Bolted

The floor panels were bolted together with six ¾-inch bolts at each side and two at each end. The panels were fastened to the pile bent caps with four ¾-inch bolts. Expansion was provided for by placing a ¾-inch expansion filler at each end of each span.

The panels were very easy to install. They weighed less than three tons and were set in final position by a truck crane picking each panel individually directly from the delivery truck. Full loading can be applied to the structure immediately after the panels are erected. It was originally planned that this feature would lend itself to opening the bridge to full width each night in the event that half-at-a-time operation was attempted. However, if the bridge were to be opened for traffic each night, it would be necessary to cut the adjacent timber stringers off at the center line of the cap adjacent to the last steel panel which was placed, in order to provide a continuous surface for the traffic to use.

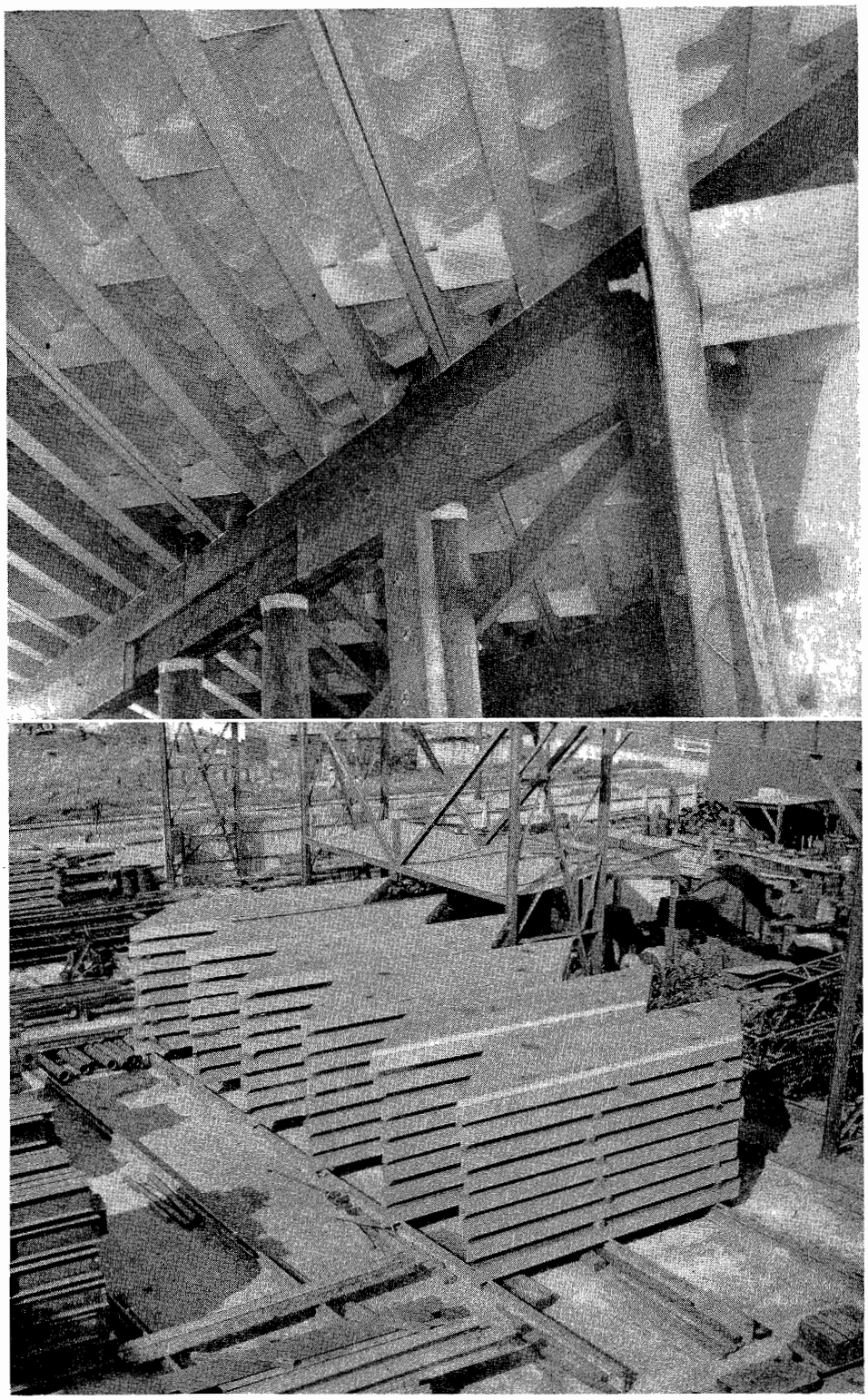
An all-steel hand rail was provided for the structure. The posts were fabricated from 6-inch I-beams on which a spring steel metal guard rail was mounted. There was no curb or sidewalk provided on the bridge. The clear roadway width was 26 feet 10 inches. A 3-inch asphaltic surfacing was placed over the metal panels.

Successful Experiment

As an experiment, the Smoky Gulch Bridge is regarded as a successful innovation. After study of the fabrication problems and the appearance of the final design, it is believed that the makeup of the panels can be considerably simplified if they are to be used in a future design.

Another problem which may prove troublesome is the successful maintenance of the asphaltic surfacing on the smooth surface of the steel deck plates. It is believed, however, that the design utilized on this structure offers great possibilities as a mass production system of replacing desert bridges.

. . . Continued on page 49



UPPER—Stiffeners used to considerable extent in original design may be considerably reduced in later applications. Cost of slightly heavier plate will be more than offset by savings in fabrication costs. LOWER—The 45 degree skew of the pile bents on the Smoky Gulch Bridge required fabrication of special sections. This special section retains all of the advantages of easy stock piling, handling, and shipping

FREEWAY AGREEMENT SIGNED WITH CITY OF POMONA

By FRANK C. BALFOUR, Chief Right of Way Agent

ON TUESDAY, May 16, 1950, the Pomona City Council passed the necessary resolution authorizing Mayor Alan G. Osborn to execute the freeway agreement with the Division of Highways covering the treatment of city streets in connection with the routing of the Ramona Freeway through that city.

Some two years ago the City Council of Pomona passed a similar resolution and the then mayor of Pomona executed a freeway agreement, which action was later rescinded because of a major controversy regarding the routing of the freeway through the city.

The controversy has finally been adjusted after many conferences and meetings, with the result that the routing of the Ramona Freeway through Pomona is the ideal one for the best interests of the traveling public and also will represent the best possible routing to serve the present and future requirements of the City of Pomona.

On Friday morning, May 19, 1950, the members of the California Highway Commission while on a tour of inspection of state highways in the easterly section of Los Angeles County, the westerly section of San Bernardino County, and Orange County, made a brief stop at the Pomona City Hall where the Highway Commission and the city council held a short joint meeting, at which time Director of Public Works C. H. Purcell presented a copy of the freeway agreement executed on behalf of the State of California, to Mayor Osborn.

This act terminated and brought to a conclusion satisfactory to the people of Pomona and to other interested sections of Southern California, a controversy of long standing, with the result that there will be no further delay in the planning and construction of the Ramona Freeway through the easterly section of Los Angeles County and extending on through Ontario, Upland, and the westerly portion of San Bernardino County as well as to and through the City of Colton in that county.

AS WE SEE IT

BY ONE OF US

The visit of the Highway Commission and other officials of the State of California to Pomona this morning marked not only a gesture of good will to the Pomona City Council, Pomona Chamber of Commerce and the community as a whole but the beginning of a new era of development and progress, according to the opinion of many who witnessed the informal but very significant ceremony.

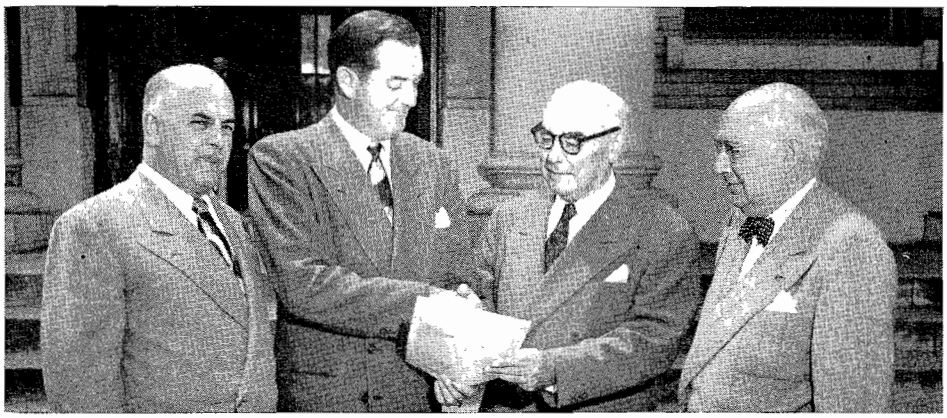
Each passing month will make more graphic the debt of gratitude which Pomona owes to the California State Highway Department. Already only three days after the signing of the freeway agreement the three-year economic coma which has held dormant the growth of Pomona is beginning to break. Plans for construction of new subdivisions and apartment houses are in preparation. Investment agencies are checking the territory. Three industries have reopened consideration of Pomona as a possible plant location city.

This reaffirmation of general faith in the future of Pomona is the direct result of the infinite patience of members of the Highway Department during a three-year period of negotiations which at times might well have discouraged their interest in holding the Ramona Freeway high on the critical urgency list.

Time after time representatives of the department came to conferences in Pomona in sincere attempts to work out the problems of Ramona Freeway in a spirit of cooperation. Even when the lack of understanding between city and State was at its worst, there was no stressing of the power of the State to transverse the city without regard to the city wishes. At any time during those past three years the State could have proceeded with either a limited access highway, which would have poured traffic through our city and left our citizens the hazard of crossing without over or underpass protection, or a freeway with no ingress or egress ramps for the use of traffic bound to and from Pomona. But through all discussions, the department held fast to the plans which their studies had shown to be for the best interests of the citizens of Pomona as well as the State.

It is to their patience and unfailing courtesy that Pomona owes the fact that construction will soon start on what will be one of the most modern parkways in the world. The sincere efforts of city councilmen, during 60 days of intensive study of freeway problems, and the understanding assistance of Highway Department personnel have opened the door to a bright future for our city. Pomona is grateful to her local public officials and deeply indebted to the entire personnel of both the State Highway Commission and the Highway Department.

Reprinted From the Editorial Page of The Pomona Progress-Bulletin, Published May 19, 1950



State delivers Pomona Freeway agreement. LEFT TO RIGHT: Frank C. Balfour, Chief Right of Way Agent; Mayor Allen G. Osborn; Director of Public Works C. H. Purcell; George Kirkpatrick, President Pomona Chamber of Commerce

El Camino Real

Calabasas Job Part of Steady Improvement of Freeway U. S. 101

By C. P. MONTGOMERY, District Construction Engineer

AMONG THE HIGHWAYS of California, El Camino Real is outstanding in historical significance. It is the route by which Christianity and the culture of Western Europe were brought by Junipero Serra and his padres to the country which now forms the Pacific Coast of the United States.

With the influx of Americans, drawn to Central California by the lure of gold and to Southern California and the San Joaquin Valley by the agricultural possibilities, the tranquil existence in old California underwent a gradual change. The ranchos of the Spanish Dons were divided into ranches of the gringos. In line with these changing conditions El Camino Real evolved into a stage road, over which transportation was provided between the Pueblo of Los Angeles and San Francisco.

These stages, built for sturdiness rather than comfort, pulled by four or six horses according to the terrain, were operated on a regular schedule. Stage stations were so located as to serve meals for the passengers where stops were made to change horses, and larger stations at overnight stops provided lodging as well as meals and "liquor, cigars and tobacco."

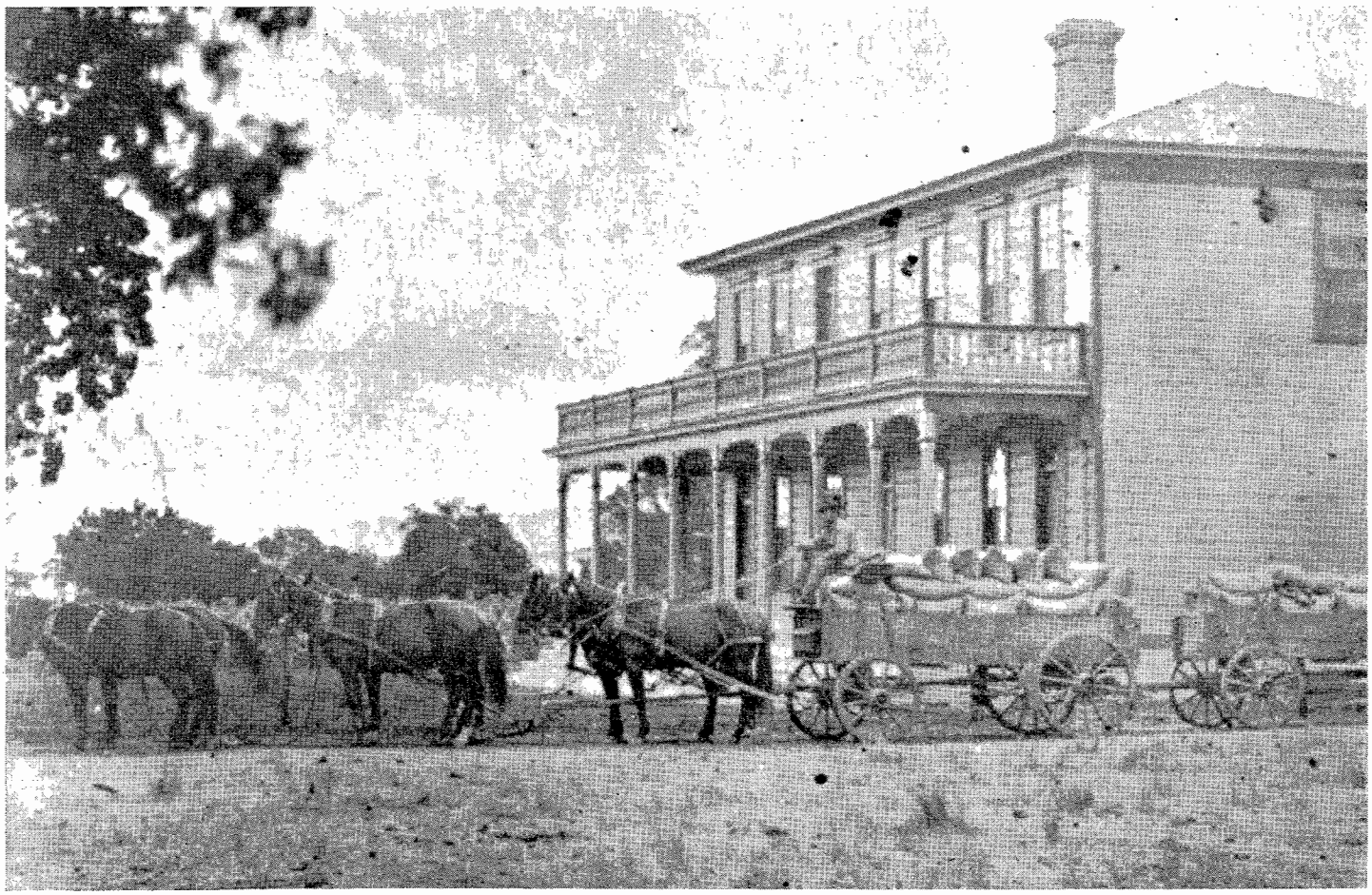
Old Stage Route

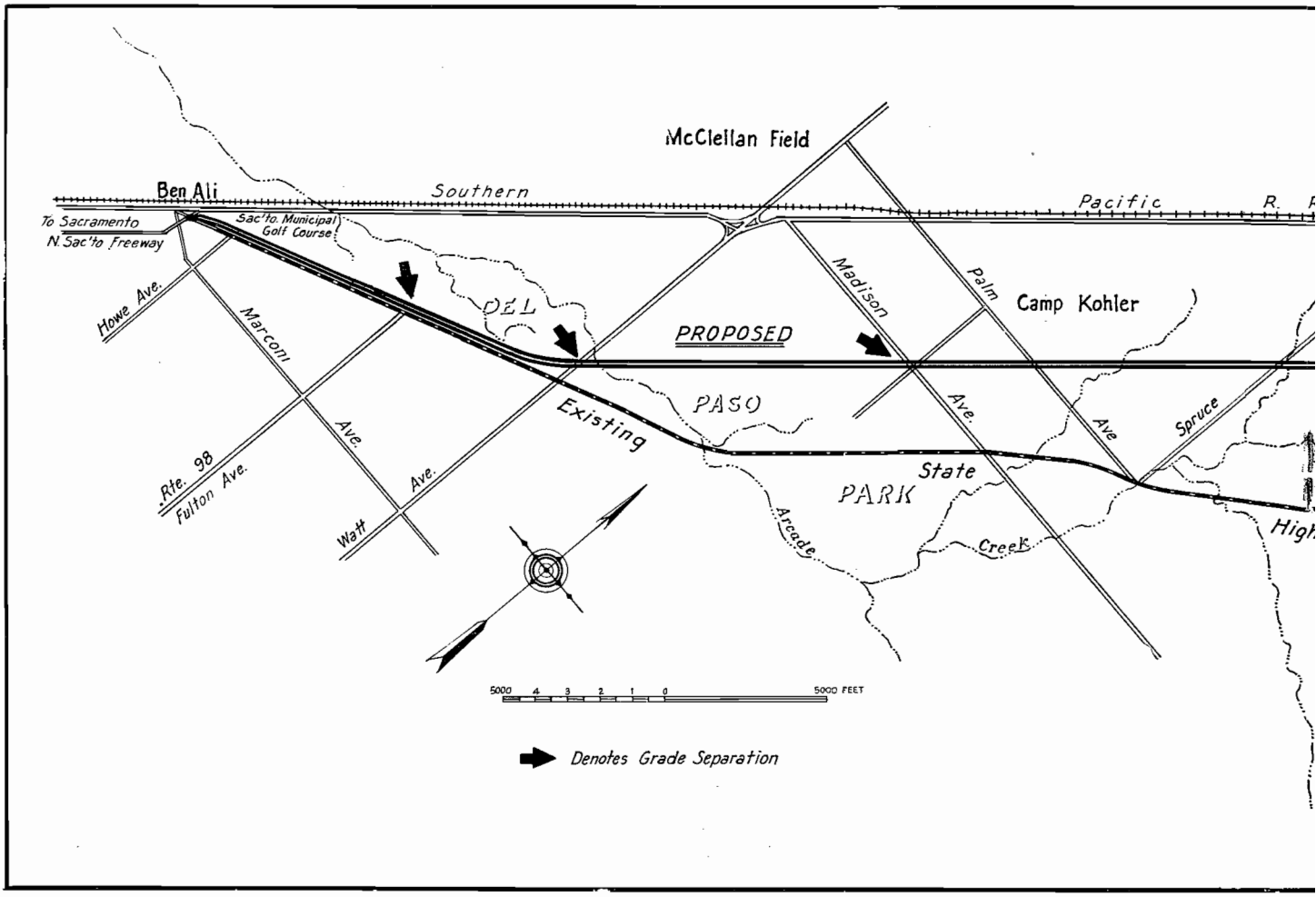
The traveler northward bound from Los Angeles in the seventies and early eighties would leave Los Angeles in the morning, stop at the Encino station for lunch while the horses were changed, probably stop again in mid-afternoon at Vejar station (now Agoura) and spend the night at Newbury Park.

Resuming his journey the following day, a change of horses was made at Camarillo with another overnight stop at Ventura. The old Vejar station, a splendid specimen of adobe construction, was in good state of preservation in 1913, but has since been torn down. The Newbury Park station still stands by the side of the present highway, minus the porch across the front and

. . . Continued on page 58

Newbury Park Stage Station in 1887





The above map shows the proposed highway relocation involved in the case of H "Existing State Highway Route 3." Plaintiffs were owners of businesses located on map as "Propose

Freeway Law

Continued from page 1 . . .

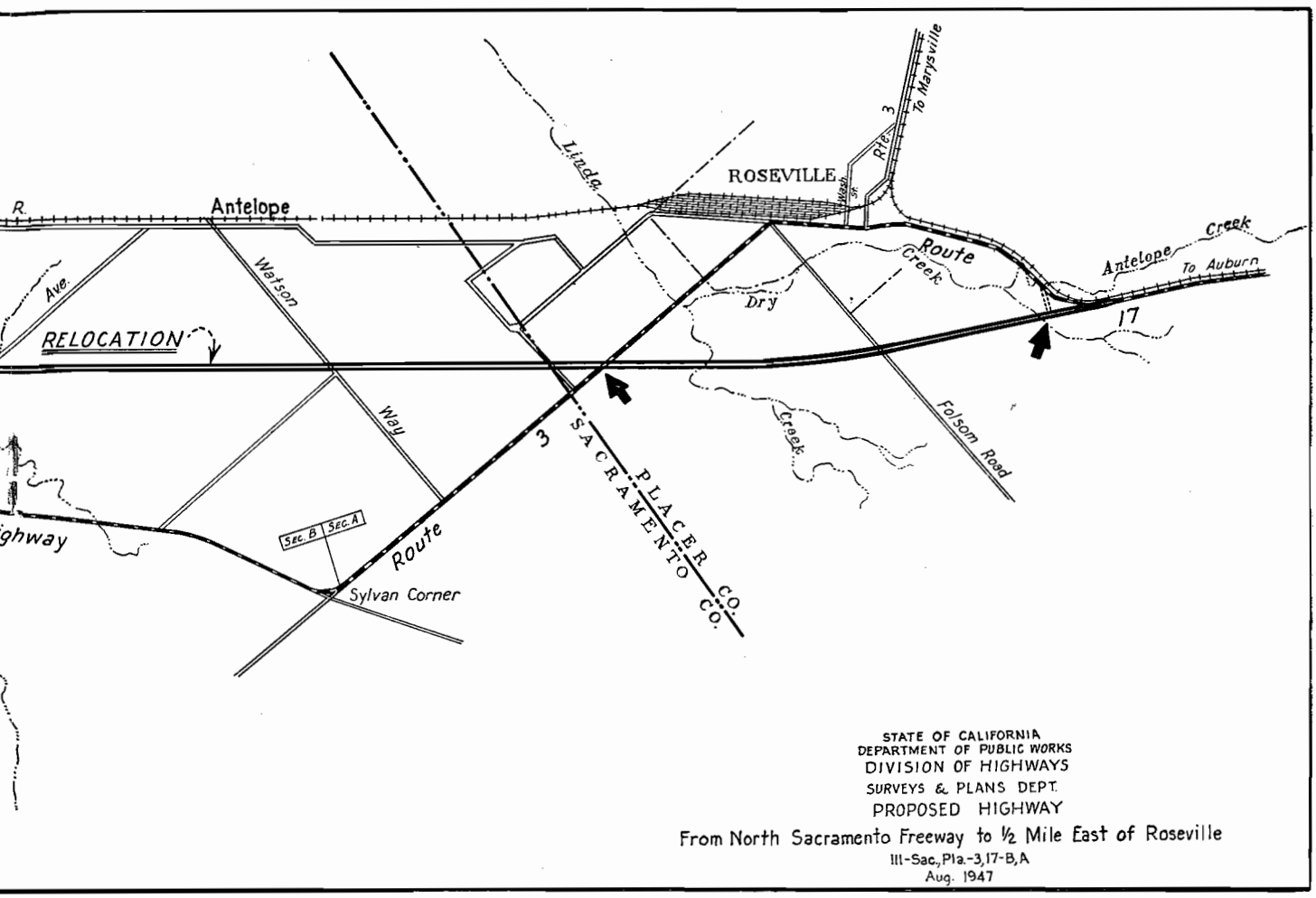
of 'permanent' in the statute is durable, not perpetual. No one can predict how long a highway will serve the purposes for which it was constructed. The first sentence in Section 8 upon which plaintiffs rely requires that highways be constructed of durable materials to insure a free flow of traffic over highways that are adequate to carry it, not to compel the perpetuation of routes that have outlived their original usefulness."

On the question of the construction of the phrase, "permanently maintained and controlled by the State of California," the court continued:

"The requirement of permanent maintenance is not one of permanent location. The purpose of this requirement is obviously to insure state maintenance of the highways so that the burden of maintenance will not fall upon the counties. This provision must be read in connection with the preceding sentence, to the effect that the counties are responsible for the interest on the bonds issued by the State. After the relocation of the part of Route 3 now proposed has been concluded the State will still be controlling and maintaining the highway specified as part of the system described in Section 4 of the 1909 act, namely, 'a continuous and connected State Highway System running north and south traversing the Sacramento and San Joaquin valleys * * * by the most direct and practical route.' The requirement of permanent maintenance does not preclude the State from relocating a highway and thereafter maintaining it as relocated. * * *"

In further support of its interpretation, the court pointed out that the State Department of Engineering, which was empowered to establish and administer the highway system provided for by the Highway Act of 1909, actually had been created two years before (Stats. 1907, Chap. 183) and had been, in the act creating it, expressly authorized to relocate, as well as to construct, "roads which have (had) been declared state highways." As the court pointed out, "there can be no question that the express authority to relocate state highways when necessary in the public interest is one of the 'things necessary and proper' to the maintenance of the highway system authorized by the 1909 act. * * *"

In other words, the so-called bond act roads are in no different category with respect to their relocation than other highways in the state system. This had been the position of the department's attorneys as well as the



f Holloway v. Purcell. The present location of Route 3 (U. S. 40, 99E) is indicated as on the existing highway. They opposed construction of a freeway indicated on the osed Relocation."

conclusions of the Attorney General, whose specific opinions approving major relocations were cited to the court.

Thus, 40 years after it was approved by a vote of the people in 1910, the basic highway legislation of California has been interpreted, as the court says, "in accord with the administrative, legislative, and judicial interpretation that it has always been given."

Such major relocations as that on the Ridge Route between Grapevine Station and Castaic, in Shasta County around Shasta Dam and Reservoir, the by-passing of Davis, Dixon, Vacaville and Fairfield, as well as many others completed and contemplated, all of which without question can be shown to be "necessary in the public interest," if there ever was any legal question as to their propriety, are now by the decision in *Holloway* v. *Purcell* fully and finally validated.

The second major proposition put forth by the plaintiffs in the *Holloway* case was that construction of freeways in California is invalid.

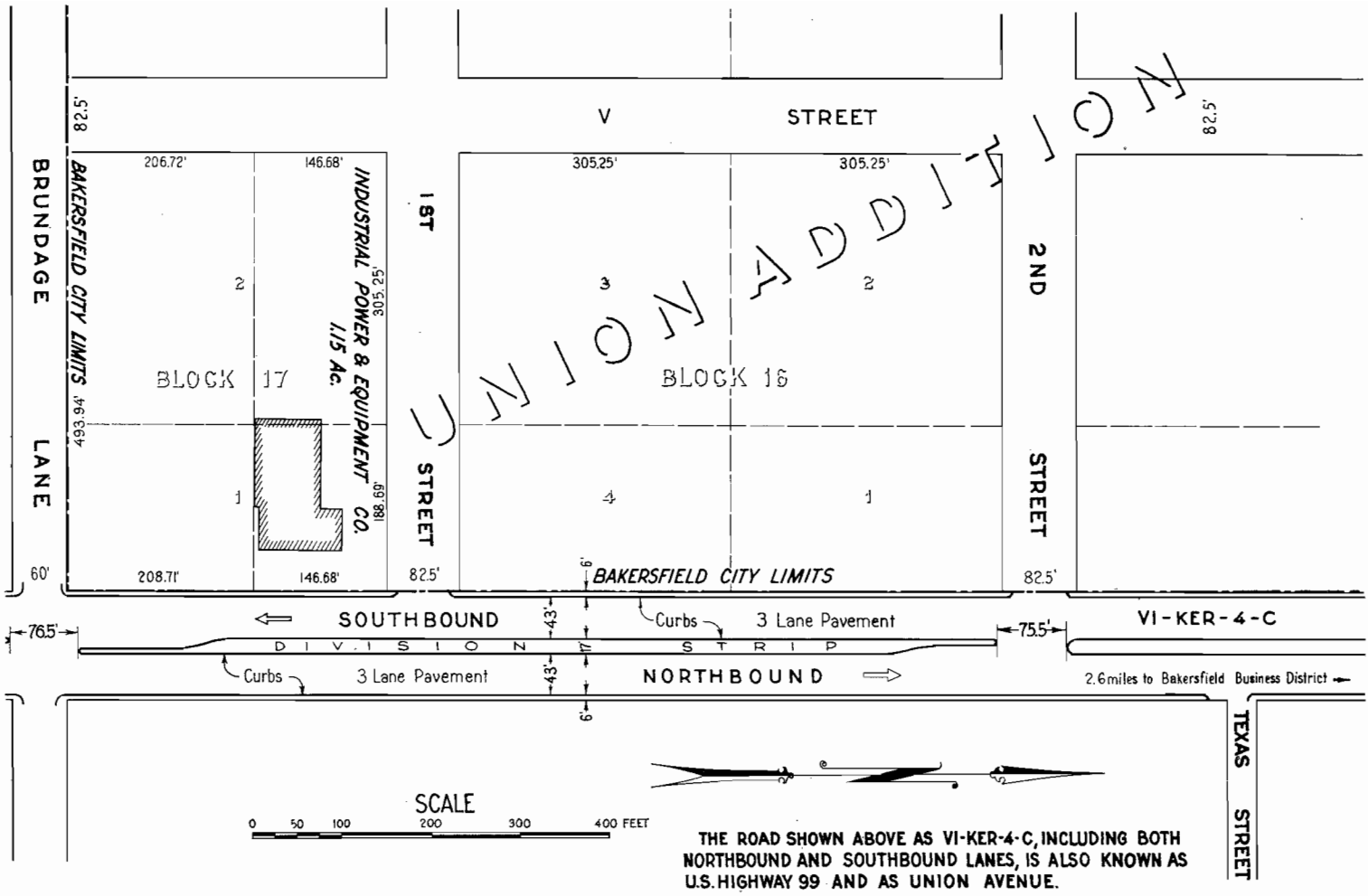
It was their contention that Article IV, Section 36, of the State Constitution, adopted by the people nearly a half century ago, and providing that "the Legislature shall have power to establish a system of state highways * * * and to pass all laws necessary and proper to construct and maintain the same" precluded the Legislature from authorizing "relocation of any highway once established under that section" as well as "construction of any type of highway not in general use in 1902"!

To this the court replied that the constitutional provision was designed "solely to authorize the establishment of a State Highway System." It refused to read into it an "unwritten provision" that would preclude relocation of "highways once established" as might be "required by changed conditions."

Freeways Held Necessary to Modern Highway System

And, in approving the 1939 statute providing for a type of highway now required by "changed conditions," Justice Traynor had this to say regarding the California freeway legislation:

> "The construction of freeways or limited access highways is within the statutory authority of the State Highway Commission and the Department of Public Works." (Citing Streets and Highways Code Sections 100.1, 100.2, 100.3.) "In their (plaintiffs') view, the Constitution prohibits the construction of any type of highway not in general use in 1902, when Article IV, Section 36 was added to the Constitution. It is contended that inasmuch as freeways



The situation in Holman *v.* State of California *is shown on the above map. Plaintiffs were owners of property at the northeast corner of First Street and the state highway (VI-Ker-4-C). They claimed extension of the center division strip across the intersection of First Street damaged their property*

and limited access highways cut off access from cross streets and highways, statutes purporting to authorize their construction are unconstitutional. That contention is without merit; it attributes to the California Constitution a rigidity that would freeze the highway system into routes that in time might bear no relation to traffic.

"The Constitution authorizes the Legislature to establish a system of state highways adequate to meet the needs of the State, 'and to pass all laws necessary or proper to construct and maintain the same.' The type of highway that is adequate to meet traffic needs necessarily varies with the character and extent of those needs. Highways adequate for the horse and buggy traffic of 1902 are not adequate for the high-speed motor traffic of 1950. Highways that satisfactorily connected rural communities have been replaced by super-highways, parkways, and freeways designed to meet the needs of heavy interurban automobile, truck, and bus traffic. * * * Their construction is not constitutionally prohibited by a provision authorizing the establishment of a State Highway System merely because there was no need for them when the provision was adopted.

"We conclude that the construction of freeways and limited access highways is 'necessary or proper to construct and maintain' a modern State Highway System."

The court then went on to say that "The construction of a freeway does not, as plaintiffs contend, necessarily constitute a taking of private property rights of access without due process of law." However, the court was careful to point out that "rights of access restricted by the construction of freeways are taken or damaged by the State under its power of eminent domain and their taking is compensable under Article I, Section 14." It should be pointed out here that the department has never contended otherwise and did not so contend in the instant case. Justice Traynor pointed out further that the Supreme Court has "repeatedly held that it is permissible to take or damage rights of access for which compensation is paid in the construction of a freeway."

On the question of plaintiffs' asserted injury to their busineses by relocation of the highway which, in essence, was real basis of their complaint, the court held that while this might be true, it did not deprive them of any "rights of access as abutting owners," and that "construction of the highway past their places of business gives them no vested right to insist that it remain there." What plaintiffs were really contending

for, the court said, quoting from the State's brief, was "a changeless road in a changing world." This, it held, they were not entitled to.

Thus the well established rule that diversion of traffic is not a compensable element of damage in a highway eminent domain case is again upheld in California.

In their brief, and particularly at the oral argument, plaintiffs vigorously contended that the Legislature was without power to delegate to "a minor administrative body," such as the California Highway Commission, authority to designate and to construct freeways and that the freeway sections of the code "improperly" delegated such authority.

This was an important point, since it constituted an attack upon the validity of numerous acts of the commission taken since enactment of the freeway law in 1939, as well as the expenditure of many millions of dollars on freeway projects. But here again the court was not impressed by plaintiffs' arguments. It said "The Legislature * * * may establish a broad statutory rule and delegate to an administrative agency the duty of specifically applying that statute within the framework of a sufficiently definite primary standard. 'The practice of delegating to administrative officers or boards powers which were originally performed directly by the Legislature is of long standing and has met the approval of the highest courts in this State as well as in other jurisdictions.' * * * An administrative agency may properly be given the authority to construct and maintain or to abandon and relocate highways, to build freeways or limited access highways, and to do anything else necessary to the maintenance of a State Highway System.

"The statutes in question require the commission to exercise its authority only on 'such terms and conditions as in its opinion will best subserve the public interest.' That requirement provides an adequate standard to guide the commission. * * * "

" 'The Legislature,' the court said in its concluding paragraph, 'has adopted a policy of freeway construction in the public interest. It has properly delegated to the highway commission the authority to determine when and where freeways will be constructed, and it has properly required that the authority be exercised in accord with the needs of the public interest. Such a delegation of legislative power is valid.' "

In other words, the freeway law is *constitutional.*

It may now be said on the authority of *Holloway* v. *Purcell* that whenever the Department of Public Works and the California Highway Commission determine to relocate or reconstruct state highways, to relinquish or abandon superseded portions thereof, or to establish and construct highways as freeways, or otherwise to exercise the powers which the Legislature has delegated to the department and the commission with respect to the state highways, their authority so to do will not be subject to question, if they act, as they have in the past, in good faith to "best subserve the public interest."

The State's brief in the *Holloway* case was largely the work of Mr. C. R. Montgomery, late Chief Counsel for the Department of Public Works. His well known ability to present a clear, incisive, and powerful legal argument was never better demonstrated than in this instance. His appearance at the hearing before the Supreme Court shortly before his untimely death may be considered his last important assignment for the department. He did not live to know the outcome of this important litigation, but those of us who were associated with him for so many years in the legal work of the department will always remember Clifton Montgomery when we have occasion to review the record in *Holloway* v. *Purcell*.

The second of the recent highway cases, *Holman* v. *State of California, 97 A.C.A. 282,* was an inverse condemnation action against the State for damages to abutting property solely by reason of the construction of a center dividing strip on Route 4 (U. S. 99) in the City of Bakersfield. No question of the relocation of the highway or of a freeway was involved.

In the Superior Court for Kern County, Judge Robert B. Lambert sustained the State's general demurrer without leave to amend and an appeal from the judgment was taken to the Fourth District Court of Appeal. The appellate court on April 27, 1950, unanimously affirmed the judgment for the State. A petition for a hearing in the Supreme Court has been denied by the latter court.

The situation in the Bakersfield case is shown on the accompanying map. Plaintiffs, doing business as the Industrial Power and Equipment Co., own the property at the northeast corner of First Street and the State highway, designated on the map as "VI-Ker-4-C." They are engaged in the business of servicing heavy trucks and equipment. The highway involved is, as has been indicated, of the conventional type which, for traffic safety, has been divided, as shown, into opposing lanes by a center division strip consisting of a concrete island some 8 inches high and 6 feet wide extending down the center of the highway and across its intersection with First Street. This dividing strip is the improvement complained of and the alleged damage was based on the fact that vehicles moving in a northerly direction on the State highway may not now make a left-hand turn through the center strip and across the southbound lanes directly into plaintiffs' property, and, likewise, vehicles leaving plaintiffs' property may not proceed directly across the southbound lanes and immediately make a left-hand turn to proceed in a northerly direction.

Whether or not this factual situation resulted in a compensable damage to plaintiffs' property was the sole issue in the case.

The contentions of the respective parties are thus summarized by the court:

"It is the contention of the plaintiffs (property owners) and of the amici curiae that the plaintiffs, as abutting owners, have the right to the use of the highway in either direction and that they are entitled to compensation for any damage occasioned by the construction of a public work or improvement in the highway interfering with their access to the next intersecting street in either direction from their property.

"The defendants (State) contend that the case involves solely 'circuity of travel' or 'diversion of traffic' which is not compensable because no violation of property rights is involved; that depreciation in value, if any, resulted

... Continued on page 46

Erosion Control

Methods Used on California State Highways Discussed

By H. DANA BOWERS, Supervising Landscape Architect

California, a wrinkled ribbon of land more than 800 miles long lying between the high Sierras and the Pacific Ocean, stretches from the humid forested zone characteristic of the Pacific Northwest to arid northern Mexico, and ranges in elevation from below sea level to more than 14,000 feet. Climatic variations are extreme, as might be expected, and erosion control problems vary correspondingly. Many different types of control have, therefore, been found to be necessary.

The purpose of this series of articles is to discuss the variable factors associated with erosion which affect California roadsides, review the development of erosion control methods by the State Division of Highways, and describe erosion control processes now being employed with reasonable success to stabilize slopes on California state highways. This is the fifth installment.

It is felt that at least a few of the methods which have proved effective in California may be modified to suit conditions in other regions. Consequently, descriptions have been made as complete and are illustrated as fully as possible in order to permit duplication of these methods by nontechnical personnel.

The erosion problem on agricultural lands is another matter entirely. Since this phase of the subject is adequately treated in publications of the Soil Conservation Service we will consider here only erosion as it directly affects roadsides.

BRUSH WATTLE METHOD

THIS IS AN early method used for stabilizing fill slopes after construction. Fair control was obtained with this method, but it has several distinct disadvantages.

All operations must be done by hand labor. This means that unless a cheap source of labor is available, such as a prison road gang, a CCC crew, or WPA or its equivalent, the labor cost is so high as to make the cost of installation prohibitive.

Wattles installed in trenches intercept and hold runoff water. No further runoff can take place until the trench is filled with water to the overflow point. This condition cannot help but result in saturation of the uncompacted soil around and below the wattle, with consequent undermining or slumping and failure during storms of high intensity.

Hard, gullied disintegrated granite fill slope. Construction of log and brush crib at toe of slope is first step in repair procedure. (Near Weaverville, Trinity County)

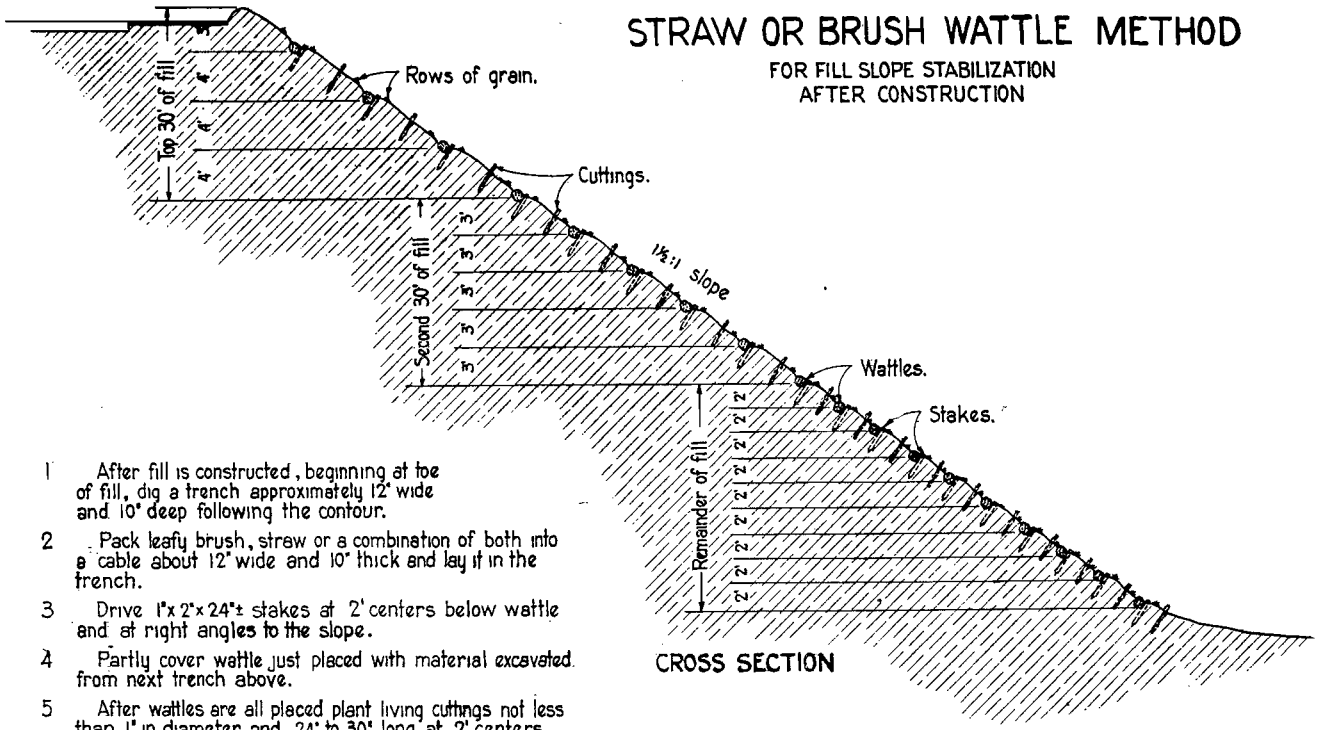
ROCK METHOD FOR FILL SLOPE STABILIZATION

An effective method used where practicable for mechanically stabilizing fill slopes involves the use of rock. In locations where excavated material containing sound rock is available within a reasonable hauling distance, chunks of rock, the larger the better, are placed in the outer portion of the embankment as the fill is made. Portions of the embedded rocks protrude from the fill surface. Since the rocks themselves are not subject to erosion, the possibility of damage is confined to the intervening spaces where the finer surface material is exposed. This vulnerable area may be reduced or even eliminated if enough rock is available to overlay the slope surface completely. In addition to offering protection from surface erosion, the embedded stones decrease the tendency toward saturation and slumping which is so characteristic of slopes composed entirely of finer materials.

The degree of vegetative protection required on a rock-treated slope depends upon the extent of rock coverage. If very little granular material is visible, seeding plus tree and shrub planting (provided sufficient "fines" are present to support plant growth) will be sufficient. If a significant amount of exposed material will be subject to erosion, the straw and seed method followed by tree and shrub planting may be required. In any event, some planting should be done, not only to improve appearance, but to arrest the gradual downward movement of stones and gravel which

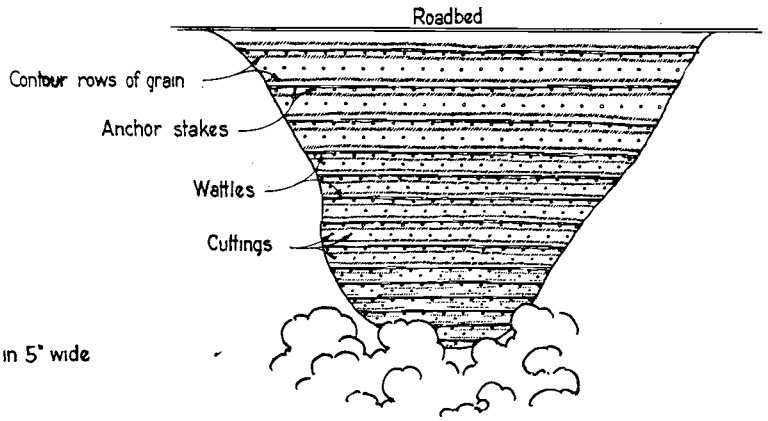
STRAW OR BRUSH WATTLE METHOD

FOR FILL SLOPE STABILIZATION
AFTER CONSTRUCTION

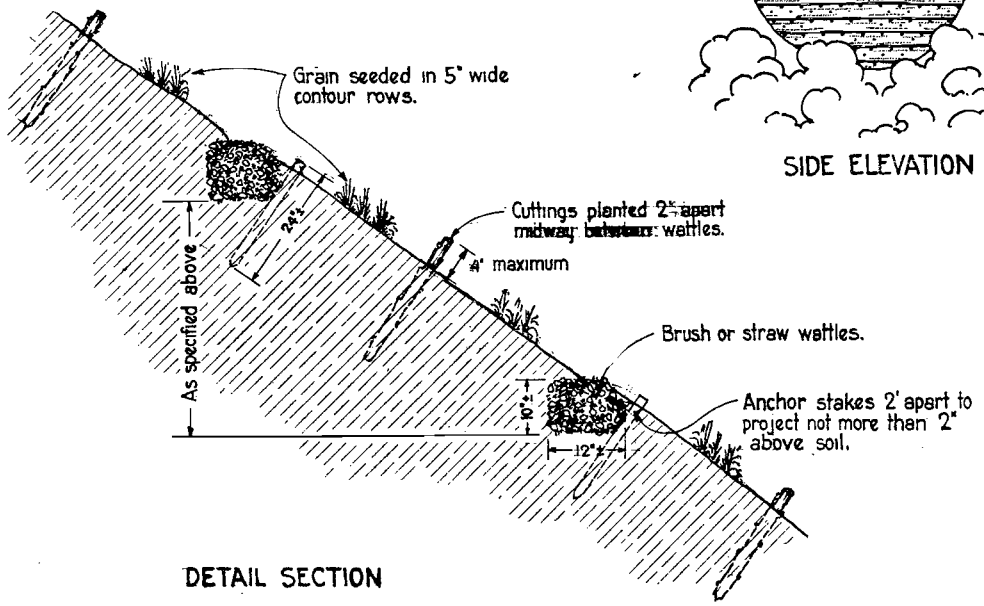


CROSS SECTION

1. After fill is constructed, beginning at toe of fill, dig a trench approximately 12" wide and 10" deep following the contour.
2. Pack leafy brush, straw or a combination of both into a cable about 12" wide and 10" thick and lay it in the trench.
3. Drive 1"x 2"x 24"± stakes at 2' centers below wattle and at right angles to the slope.
4. Partly cover wattle just placed with material excavated from next trench above.
5. After wattles are all placed plant living cuttings not less than 1" in diameter and 24" to 30" long at 2' centers in rows midway between wattles. Set cuttings in the ground until they protrude only 3" or 4".
6. Seed Barley, Rye grain or Alfalfa in 5" wide rows just above and just below each wattle and broadcast additional seed evenly over surface of slope.



SIDE ELEVATION



DETAIL SECTION

seems to be constantly taking place on unvegetated rocky slopes.

USE OF STRAW MULCHES IN SLOPE STABILIZATION

The function of a straw mulch, as previously discussed, is to afford protection to the soil until vegetation has become established. Lasting qualities of the straw are considered relatively unimportant, since after the first growing season plant growth should be sufficiently dense to retard soil movement, and the straw protection should no longer be required. Considerable latitude is, therefore, allowed in our specifications as to the type of straw to be used. Wheat, barley, oat or rice straw are usually specified as choices, although spoiled hay (alfalfa, grain, or wild-grass) would be acceptable provided it was not rotted or extremely brittle. Used stable bedding from the race tracks, consisting of barley straw mixed with horse manure, was obtained at a reasonable price by several contractors and used successfully on the high fill slopes of the City Creek Road in the San Bernardino Mountains. The type of straw used in a given locality is, therefore, governed by availability and price rather than by variety.

Straw Rollings

Rates of application are related directly to the number of rollings with the sheepsfoot roller which are specified, and the type of soil encountered. Each pass with the sheepsfoot roller presses some of the straw so deeply into the soil that it is no longer visible or effective as surface protection. Highly erosive soils, then, which require the thorough compaction which many trips of the roller will produce, the consolidating influence of the embedded straw and also the surface protection provided by protruding straw, require a higher rate of application than less critical soils.

Ordinarily, an application of four tons of straw per acre is specified. This rate is based upon the quantity of average quality straw of the variety which is most often furnished (in our case, barley) which is required, when evenly spread over a slope acre, to cover the average soil to such depth that after one rolling with a sheepsfoot roller enough straw will remain exposed on the surface to afford protection. The accompanying illustrations show the normal application of four tons per acre both before and after rolling. A rate of six to eight tons of straw per acre is usually specified in locations where the degree of compaction desired calls for from six to as many as twelve passes with the roller, in order to insure that enough straw will remain on the surface after the rolling operation has been completed. Since the sheepsfoot roller will not compact the soil effectively if the straw blanket is spread at an appreciably heavier rate than four tons per acre, the six- to eight-ton covering is spread in two applications, each followed by a thorough rolling.

Unit of Measurement

Short, brittle or very coarse straw does not cover the slope surface so well as new long-stemmed straw; and if only straw of this poorer quality is available, the rate of application should be increased until a sufficiently thick covering is left on the surface after rolling to offer the protection desired.

The unit of measurement, "tons per acre," has been found to be the most practical unit to use. Bales of straw vary both in size and weight, and the unit "inches depth" is too dependent upon whether the straw is stiff or limp or has been baled tightly or loosely.

In all cases where slope surface protection areas are involved, the terms "acre" or "square yard" refer to slope measurement.

USE OF SHEEPSFOOT ROLLER IN SLOPE STABILIZATION

Several methods have been developed for utilizing a sheepsfoot roller in compacting the slope face and incorporating the straw with the soil.

When rolling 1½:1 and 2:1 cut slopes, a single roller equipped with a yoke has been connected by wire cable to the power-operated drum unit located on the back of a Caterpillar tractor. The roller is lightened of ballast to the point where it will roll down the slope when the cable is slack but is not so heavy as to cause an excessive load on the power unit when being pulled back to the top of the slope.

The tractor is positioned at the top of the slope, broad side to the slope face. The roller is let down, speed of descent being controlled by the power unit brake, then pulled to the top of the slope. After the required number of round trips are made, the tractor is moved a distance equal to the width of the roller and the process repeated.

Rolling Cut Slopes

While this method has been most often used for rolling cut slopes, it is also adaptable for rolling embankment slopes, although more roller ballast may be required in order to load the roller to the point where it will roll down the slope of its own weight in the looser soil.

When 1½:1 embankment slopes composed of very loose or granular soil, such as disintegrated granite, are to be rolled, it may be necessary to give the slope one preliminary rolling before straw is spread in order to compact the soil lightly. If straw is spread on very loose soil, the roller tends to push the straw and loose soil ahead of it on the first downward trip.

When straw is spread on the completed portion of a fill slope at stages during construction of the fill, a long arched extension tongue has been used to connect a standard two-section sheepsfoot roller directly to the tractor drawbar. The tractor is backed to the top of the slope, the roller being let down over the edge, and the required number of round trips are made by moving the tractor forward, away from the top of the slope, and back, for a distance equal to the length of the tongue.

An advantage of this method is that the tractor and roller may be used for compacting fill material without rerigging during the period while the fill is being built up to the next stage.

No Great Problem

Rolling flatter slopes offers no great problem. Equipment can often work directly on the slope, and a standard two-section sheepsfoot roller hitched directly to a tractor has been used to roll the slope longitudinally.

A truck crane has also been used to roll low cut and fill slopes lengthwise. Two cables are attached to the roller,

one to control the position of the roller on the slope and the other to pull it. Care must be taken with this method so that the axis of the roller is at right angles to the direction of the pull, since a skewed roller has a tendency to pick up straw from the surface of the slope.

High fill slopes can be effectively rolled with a heavily weighted two-section sheepsfoot roller, provided a cable winch of sufficient power and braking capacity is available. A truck crane has proved very efficient for rolling slopes of as much as 300-foot length in the mountains of Southern California.

After straw is spread, the roller, connected directly by cable to the winch, is stationed at the top of the slope and allowed to roll to the bottom by its own weight, the speed of descent being controlled by the winch operator. It is then pulled back to the top of the slope and the cycle repeated until the required number of round trips of the roller have been made. The crane boom cable is then hooked to an eye attached to the roller frame, the roller hoisted free of the slope, the truck moved forward a distance equal to the width of the roller, the boom cable unhooked, and the rolling resumed.

REPAIR OF FAILURES ON NEWLY STABILIZED SLOPES

A few failures are almost inevitable during the first winter after installation of any type of slope stabilization treatment. The extent and seriousness of these failures is usually directly related to the intensity of the first storm of the season, which occurs before vegetation has started growth and before the soil has become completely consolidated. Prompt and effective repair of sections which have failed is extremely important, since no further loss of soil then takes place and the repaired area becomes stabilized during the remainder of the rainy season.

The most frequently observed type of failure is surface slippage. If the slip starts at the top of the slope or near the top, it is likely that seepage or percolation of water from above through a porous layer of subsoil is causing the damage. This percolation

Brush is placed in gullies before backfill material is spread on slope face. Note log and brush crib at toe of fill. (Near Weaverville, Trinity County)

may be intensified by standing water in a poorly graded intercepting ditch or leakage through cracks in a paved shoulder or drainage ditch. Small amounts of runoff water of insufficient quantity to cause gullying may also cause this type of failure. Since saturation in this case is caused by water which originates elsewhere than on the slope face, a necessary preliminary to repair is correction of the defective drainage condition.

Causes of Slips

Slips which start on the lower two-thirds of the slope, or below, are usually caused by saturation of the soil due to lack of sufficient compaction before the rains start. On cut slopes, insufficient roughening of the subsoil before topsoil is applied sometimes increases the tendency toward slippage. Since this condition cannot be corrected after the slippage has occurred, and since rainfall which has caused the damage has also compacted the portions of the slope which have not failed to the point where further failure is unlikely, corrective operations can be restricted to simple repair.

If failures appear on cut slopes which have been given Type "C" stabilization treatment, the area from which surface soil has slipped need not be backfilled with topsoil as part of the repair process. Sufficient topsoil particles are usually left to support some plant growth, and a replacement layer of topsoil would be subject to the same conditions which caused the original failure. Furthermore, any cultivation of the exposed subsoil is considered unnecessary, since loose soil would then be subject to saturation and possible loss.

Repairing Slip Damage

The most economical and satisfactory method for repairing surface slips has proved to be fertilization and heavy seeding of the exposed subsoil and the application of a straw mulch, held in place, if necessary, by a few shovelfuls of loose soil. The sooner this method is employed, after failure, the better, since moisture already in the soil will germinate the seed and the straw covering will retard further soil loss. Cereal grain seed is used for this purpose because it will germinate quickly and successfully beneath a straw mulch, is easily obtainable, and is inexpensive. This treatment may be supplemented by planting cuttings of ground cover plants or shrubs.

Extensive gullies sometimes appear on highway slopes, caused by a concentration of runoff water from above due to berm failure, plugged downdrains or inadequate diversion ditches. After the condition causing the concentration of water has been corrected, moderate-sized gullies may be repaired as described above. If the gully threatens the traveled way, backfilling is sometimes necessary, and in

Reworking fill slope face with bulldozer and installing brush layers. (Near Weaverville, Trinity County)

this event care should be taken that the backfill material is well compacted during application.

Rills which develop on a recently constructed slope which has not been covered with straw may be treated with seed alone, or straw and seed if the soil appears to be extremely erosive.

Since most of these repaired areas do not fail during the storm following treatment, the necessity for repair work lessens year by year, until complete control is established.

REPAIR OF OLD ERODED SLOPES

Light cultivation of the compacted soil is a necessary preliminary to successful repair of old eroded slopes which do not require rebuilding. If seed is sown on uncultivated and gullied soil, the seed tends to concentrate in pockets in the bottoms of the gullies, and a large proportion rolls to the bottom of the slope and is lost. The cultivating operation creates a more favorable condition for seed germination, and also smooths out irregularities and breaks up channels of concentration in the gullied slope.

Cultivation should be followed by fertilization, seeding and the application of an adequate straw mulch. Thereafter, the slope should be given routine maintenance, repairs being made as soon as failures become evident.

On soil slopes, it has not been found necessary to tie the straw covering down with pegs and twine or wire to prevent serious loss by wind action. In a few days the unsecured straw blanket seems to settle and mat and is then able to withstand winds of considerable velocity without damage. This settling may be accelerated and seed germination hastened by sprinkling the straw with water after spreading. As soon as the seed germinates the straw is held securely in place, so the cost of pegs and ties simply to prevent possible loss of straw between the time of application and the time of seed germination is not considered justified. A large quantity of straw can be replaced for the cost involved in holding the blanket in place mechanically.

Storms Present Problem

Successful repair work on old eroded fill slopes in localities subject to storms of high intensity, as in the mountains of Southern California, is likely to be a long-term proposition. If the seasonal rainfall is favorable during the first year after installation, almost complete control is possible with a treatment consisting of cultivation, fertilization, straw mulch, grain seed and a thick planting of willow or Baccharis viminea cuttings. If heavy storms come before the seed and cuttings have become established, failure of portions of the treated slope can be expected, the extent of failure being dependent upon the intensity of the storm. A continuing program of failure repair is, therefore, necessary until vegetation has become completely established, after which time maintenance activities can usually be restricted to correction of defective drainage conditions as they appear.

The present-day cost of labor is so high that hand smoothing of slopes and installation of wattles is not considered economically feasible. The less elaborate methods of treatment described above are believed to be as effective in the long run if proper maintenance is forthcoming, and are certainly much cheaper to install than the wattle treatment.

Treatment of Slipouts

Large gullies or slipouts in fill slopes require more extensive treatment, since it is usually necessary to replace the material which has been lost in order to safeguard the roadbed.

The accompanying illustration shows a slope which is so badly gullied that repair is necessary. This soil, when dry, sets up so hard that it is almost impossible to walk on the slope. It is obviously unreasonable to assume that loose soil, end dumped upon a slope like this and given no further treatment, can be expected to remain in place during the following rainy season. Compaction or the utilization of some means of keying the loose backfill material to the slope surface until consolidation has taken place is essential in order to insure effective repair.

If maintenance funds are restricted, and gullies are not too large, the repair method can be relied upon to provide control in from two to three seasons.

A crib of logs and coarse brush is constructed at the toe of the fill in order to provide a solid foundation against which backfilled material can settle. Loose brush is then placed in the slope gullies and covered with a moderately thick layer of backfill material. Additional brush is spread over the surface and covered with soil. This process is repeated until the original fill contour is restored. Surface protection of the type justified by the soil and locality is then applied, and seed and cuttings of suitable plants are planted during the following planting season.

Backfill Material

Since the backfill material is not compacted by this method, we must

expect saturation, settlement and even slumping, to the extent allowed by the consolidating influence of the buried brush, during the rainy season following treatment. The area affected by this settlement is usually near the top of the treated section, however, and can be backfilled and treated as described above without disturbing the growth of vegetation on the unaffected portion of the slope. A third treatment, following the next rainy season, is sometimes necessary in order to compensate for further settlement of the backfill material, but under average conditions very small areas are involved and the cost is not high.

If gullies are so large and the danger to the roadway so great that the fill slope must be fully restored immediately, the method illustrated here is recommended.

CONCLUSIONS

The most successful erosion control methods have proved to be those which reproduce most closely conditions which are to be found on natural slopes. Mechanical or unnatural methods of control, while sometimes immediately effective, deteriorate with time and show up poorly in the long run as compared with methods that follow natural vegetative processes. If we work with Nature, erosion control problems are simplified and the probability of success becomes more certain than if we disregard the examples of successful natural stabilization to be found on every hillside and proceed to attack the problem from a mechanical angle.

By artificially speeding up the stabilization process, thereby creating conditions in one season which Nature could not duplicate in several years, we find that we can shorten the time required for complete control.

Much of the value of slope stabilization treatment is lost unless proper maintenance can be given during the all-important first and second years after installation, and as required thereafter. Cost of timely maintenance is not high, but neglect can bring about increased and unnecessary expenditures due to the necessity of cleaning gutters and repairing gullies which threaten the traveled way, and of frequently rebuilding portions of roadways at fill locations.

Flatter Slopes Favored

Highway construction standards now encourage the use of flatter slopes in erosion-prone soils. Flatter slopes allow the use of thicker blankets of topsoil which can support a more vigorous growth of vegetation without tending to slump when saturated. Control problems are eased considerably, and the need for maintenance reduced.

As new successful erosion control projects are completed and the consequent reduction in maintenance cost for repair of erosion-caused damage becomes more evident, highway employees are taking a greater interest in the program. Highway engineers have been particularly cooperative in developing methods which would be both practical and effective, and highway maintenance forces have become more conscious of the value of prevention. There is still a decided need for continued educational work, however, especially in regard to effective methods for repair of old eroded slopes, and it is believed that eventually this work will be done as a matter of course.

Work Will Continue

Experimental work will be continued. Even though it is felt that considerable progress has been made, too many questions remain unanswered and too many partial failures result from high-intensity rains to allow us to believe that the most effective methods have yet been developed.

This method involves reworking the entire outer surface of the affected portion from the bottom up. A log and brush crib is first constructed at the toe of the fill to offer a solid foundation against which the soil can be compacted. Backfill material is furnished from the top, and a tractor equipped with a bulldozer is used to spread, compact and shape this material to the original fill contour. Brush layers are installed at suitable intervals as the fill is built up. (See brush layer method detail sheet.) The completed slope is then given surface protection, including a thorough rolling, if possible, and suitable seed, plants and cuttings are planted at the proper time.

THE END

Reprints of the entire series of articles by Mr. Bowers, including specifications, will be available at an early date.

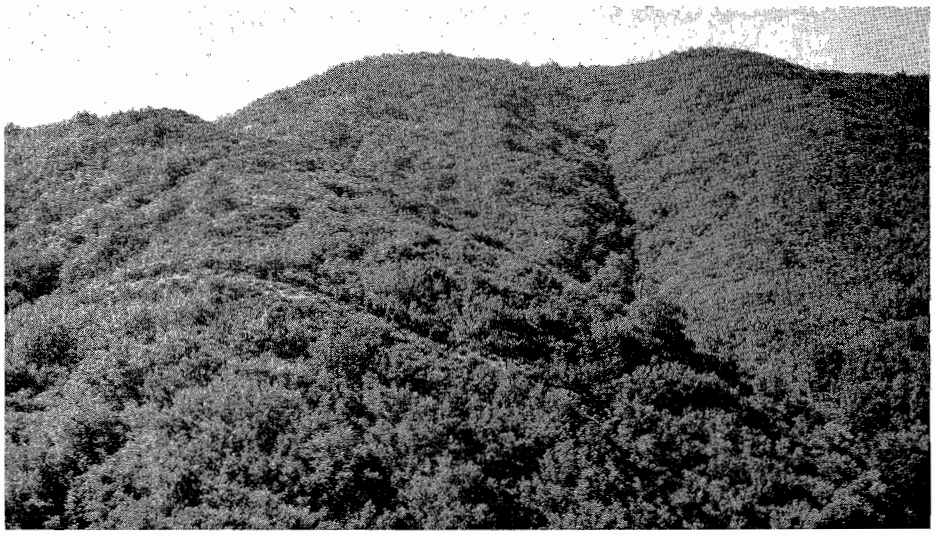
ACKNOWLEDGMENTS

Grateful acknowledgment is hereby made to the many persons who, by their suggestions and encouragement, have contributed to the preparation of this booklet.

Special acknowledgment is due Mr. Chas. C. Morris, Division Engineer of the Public Roads Administration, for suggesting that a publication describing our erosion control methods would be of interest to others faced with similar problems; and later for his review and suggested improvements in the manuscript. Also to Mr. Wilbur H. Simonson, Chief, Roadside Section, Public Roads Administration; Mr. C. J. Kraebel, Division of Forest Influences, U. S. Forest Service; Mr. J. S. Horton, San Dimas Experimental Forest, U. S. Forest Service; Professor Joseph Kittredge, Professor of Forestry, Forest Influences, University of California; and Mr. C. H. Gleason, Forester, U. S. Forest Service, for their valuable suggestions and constructive criticism; and to Mr. L. S. Manning, Associate Landscape Architect, California Division of Highways, for his compilation of this manuscript.

H. DANA BOWERS

Nature's way. A completely stabilized slope



Black Point

Improvements on Sign Route 37 Look To Future Four-Lane Divided Highway

By CHAS. SCHEMEL, Resident Engineer

THE FIRST seven miles of State Sign Route 37, known as the Black Point Cut-off, runs in a northeasterly direction from the Redwood Highway, U. S. 101, at Ignacio in Marin County, to a junction with the Sears Point Cut-off, State Sign Route 48, at Sears Point.

From this junction the Black Point Cut-off branches off northerly to the Sonoma and Napa Valleys, while the Sears Point Cut-off branches off in an easterly direction toward Vallejo and the American Canyon Route to Sacramento and interior points.

This seven-mile section of the Black Point Cut-off, therefore, carries the full traffic load bound to and from the Golden Gate Bridge and Marin County to the Sonoma-Napa-Vallejo areas and beyond.

Commuter traffic to the U. S. Air Force base at Hamilton Field in Marin County, and the Mare Island Navy Yard base at Vallejo, add considerably to this traffic.

Road Graded in 1916

This section of road was originally graded to a width of 24 feet in 1916, that portion over the tidelands being constructed from material excavated from borrow pits immediately adjacent to the roadbed. An 18-foot width asphalt concrete pavement was placed on this grade in 1922.

The section of the old road through the foothills near Black Point in Marin County, and near Sears Point in Sonoma County, contained limited sight distances and steep grades which were standards at that time.

With the construction of the Golden Gate Bridge and general development of the North Bay area, the steep grades and sharp curvature, with limited sight distances, caused serious traffic congestion on this section of roadway.

The deep borrow pits paralleling the roadway also added to the accident hazard.

UPPER—Son-208-A. Shoulder widening on Sears Point Cut-off from excess excavation. LOWER—Son-8-A. Junction Black Point and Sears Point Cut-offs on relocated line looking north. Old road on right

In preparation of the 1948-49 Budget, the improvement of portions of this route was given favorable consideration by the California Highway Com-

mission, and funds were voted for improvement of that portion of the route between Ignacio and the Petaluma Creek Bridge in Marin County.

Funds for that portion of the route from the Petaluma Creek Bridge to the Sears Point Junction in Sonoma County were included in the 1949-50 Budget.

The improvement of the section in Marin County was let to contract construction in December, 1948, Parish Brothers of Benicia being the successful bidders.

This contract consisted of a relocation of the road through the range of hills just west of Petaluma Creek, where a cut 100 feet in depth required moving some 350,000 yards of earthwork to construct the grade.

Steep Grades Eliminated

The roadbed was graded for a four-lane divided freeway section, of which two lanes 0.8 mile in length on the new location were surfaced to accommodate present traffic.

Surplus material from the excavation was used to construct the embankment for two additional lanes of a future four-lane divided freeway across the 2¼-mile marshland area between Ignacio Wye and the foothills.

While this new location is only 0.1 mile shorter than the old road, it eliminates steep grades and the 200-foot radius curve at the westerly approach to the Petaluma Creek Bridge.

Work on this contract was completed in January, 1950, at a cost of $526,000, of which $116,000 was for purchase of right of way and for clearance of utilities and obstructions.

A second contract, covering the work from Petaluma Creek to Sears Point Junction, was started in October, 1949, by Piambo Construction Company of San Francisco, and will be completed in the fall of 1950.

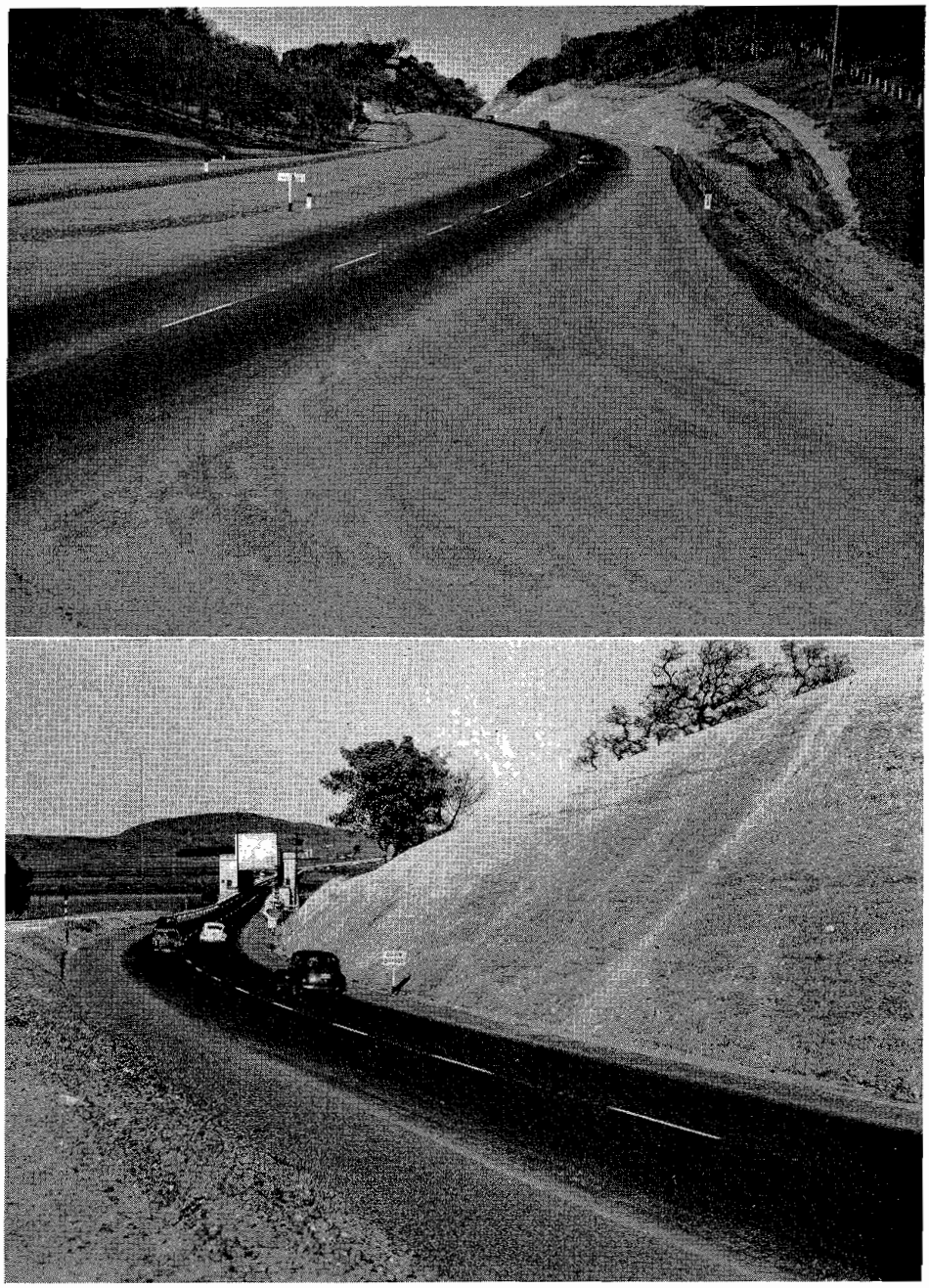
Future Four-lane Highway

The work in general is similar to that completed in Marin County, material from the 75-foot cut near the northeasterly end of the project being used to construct the roadbed for future development of a four-lane divided roadway across the 2.7 miles of reclaimed tidelands to the southwest.

The new alignment through the hill at Sears Point will be paved to provide a four-lane divided highway 1.2 miles in length, with a six-foot minimum curbed division strip and a channelized intersection at the junction of the Sears Point Cut-off.

The 4.6 percent maximum grade and 5,000-foot radius curve replaces the existing 6.5 percent grade and several 500-foot radius curves and long sections of nonpassing sight distance.

The plant-mix pavement on both of these projects is placed over a cement treated base.



UPPER—Completed section of Black Point Cut-off, Mrn-1-A, looking north. Graded section for future divided freeway on the left. LOWER—Completed section of Black Point Cut-off, Mrn-1-A, looking north at new approach to Petaluma Creek Bridge

The excavation from this relocation also provides sufficient material to permit widening of the narrow shoulders on the Sears Point Cut-off from their existing 3-foot width to a 10-foot width, between the Sears Point Junction and the district boundary at Sonoma Creek.

The Sonoma County project is estimated to cost $684,000, of which $84,000 is for right of way and clearance of utilities and obstructions.

New Freeway

Unit Between Cottonwood and Redding In Shasta County Is Dedicated

ONE OF the main events of the Shasta County Centennial Celebration, marking 100 years of progress in Shasta County, was the dedication of the new limited access freeway on Pacific Highway U. S. 99 between Cottonwood and Redding.

At a ceremony on June 15th sponsored jointly by the chambers of commerce of Redding, Anderson and Cottonwood, Frank B. Durkee, Deputy Director of Public Works and guest of honor, officially dedicated this modern highway which will be completed this year at a total cost of more than three million dollars.

In connection with the dedication ceremony prior to the ribbon cutting, close to 200 local citizens attended a luncheon at the Anderson Fairgrounds honoring Mr. F. W. Haselwood, recently retired district engineer. Included among the luncheon guests were state, county and city officials, members of the various local chambers of commerce and service clubs, and prominent civic leaders.

Gillis Principal Speaker

Assistant State Highway Engineer R. M. Gillis was the principal speaker, and in paying tribute to Mr. Haselwood, traced his entire 38-year career with the State, and pointed out his foresight in the planning of the Cottonwood-Redding Freeway. He told of the tremendous growth in population and motor vehicle registration in the State during this period, and mentioned with pride the fact that California is second to none in modern highway development. He stated that since 1932, when Mr. Haselwood came to District II, there has been spent within the district $19,000,000 on highway maintenance and $40,000,000 on new developments.

As one of the highlights of the luncheon William A. Quinlan, Chairman of the Roads and Highways Committee of the Redding Chamber of Commerce, on behalf of the chamber of commerce presented Mr. Haselwood with a framed resolution commending him on his faithful service and many fine achievements. Mr. Haselwood replied that, after having performed work that he liked for 38 years, it was very gratifying to find out that so many people liked what he had done.

William A. Quinlan presents to F. W. Haselwood, retiring District Highway Engineer, a resolution adopted by the Redding Chamber of Commerce commending him for his long service

Trask New District Engineer

Senator Edwin J. Regan, from Trinity County, in a brief address introduced Mr. James W. Trask, successor to Mr. Haselwood as district engineer. Mr. Trask expressed the sincere hope that the new highway being dedicated would successfully fulfill one of its main objectives, the reduction of accidents and a saving of lives.

The dedication of this section of highway was a very fitting ceremony in connection with the centennial celebration. Almost the entire length of the project lies within the old Rancho San Buenaventura, an original Spanish land grant to Major P. B. Reading, early pioneer and prominent figure in Shasta County history during the 1850's. It was in Clear Creek, not far from the site of a modern bridge on the new project, that Major Reading first discovered gold in Shasta County in 1848. This new multilane divided highway is indeed a far cry from the old California-Oregon road, main artery of travel of the pioneers and established by them

in the 'fifties. The present highway crosses this old pioneer road in the vicinity of Spring Creek north of Anderson, where evidence of the historical wagon road is still visible.

The first unit of construction between Cottonwood and Anderson was completed in December, 1948. (See article in March-April issue of *California Highways and Public Works.*) The second unit, completed in June this year, included construction of a four-lane divided highway and a 32-foot wide frontage road through the Town of Anderson, and construction of the southbound lanes between Anderson and Clear Creek, midway to Redding. The accompanying article by W. Z. Hegy, resident engineer, describes construction of this unit.

The third and final unit now under construction includes reconstruction of the existing highway between Anderson and Clear Creek to form the northbound lanes, and construction of an additional bridge across Clear Creek and widening of the existing bridge. The completed facility will provide a modern four-lane divided limited freeway for the total 12 miles between Anderson and Redding, and will be a welcome relief to the motorists who have been traveling the old narrow and very congested road between these two rapidly growing towns.

No Parking

Continued from page 6 . . .

not take effect for 30 days, most drivers obeyed it in advance. Within a few days, the number parking along the street was noticeably less and that number steadily dwindled through the waiting period. After the signs were installed, obedience has been almost universal, and the need for enforcement slight. During the first month, police issued nothing but warning citations and surprisingly few of them. In all respects the change has met with almost universal public favor.

Driving tests made before parking was prohibited indicated an average speed of 23 miles per hour through the entire length of the 46-foot wide street, with the most congested section having an average speed as low as 19 miles per hour. Later tests, without

. . . *Continued on page 53*

Construction of Freeway Section on U. S. 99 Between Anderson and Redding Completed

By W. Z. HEGY, Resident Engineer

As an additional step in the improvement of Pacific Highway U. S. 99 between Cottonwood and Redding, a highway contract is approaching completion which will replace the present two-lane highway constructed in 1921 between Anderson and Clear Creek.

The project begins at the southerly limits of Anderson and parallels the existing road on the east side to Clear Creek for a total distance of six miles.

The contract is the second in a series of three construction projects which will replace a narrow and obsolete highway between Cottonwood and Redding.

The original pavement was placed by H. J. Kaiser Construction Company in 1921 and consists of a bar-reinforced Portland cement concrete slab 15 feet wide with subsequent widening with three-foot plant-mixed shoulders.

Maintenance Problem

The pavement has withstood usage remarkably well, considering the lack of subgrade material of good bearing value, the pavement, in general, having been laid on roadway subgrade consisting primarily of clayey material.

However, the heavy loads applied by commercial vehicles comprising freight transports, lumber trucks and logging trucks hauling to local mills have created a problem of daily maintenance on the concrete and subsiding shoulders.

In addition, the highway facility has become inadequate to provide unrestricted flow of traffic which has increased from a daily volume of 3,700 vehicles in 1940 to a present-day volume of 8,500.

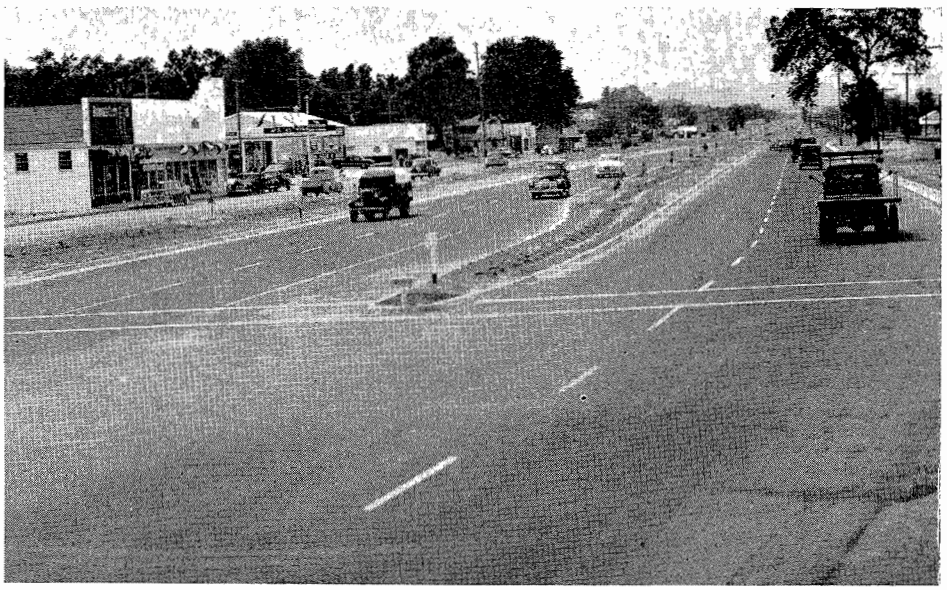
The project consisted of constructing a graded roadbed, placing imported borrow to a minimum depth of 1.25 feet, constructing a six-inch thickness of cement-treated base and placing a three-inch course of plant-mixed surface of open-graded and dense-graded material.

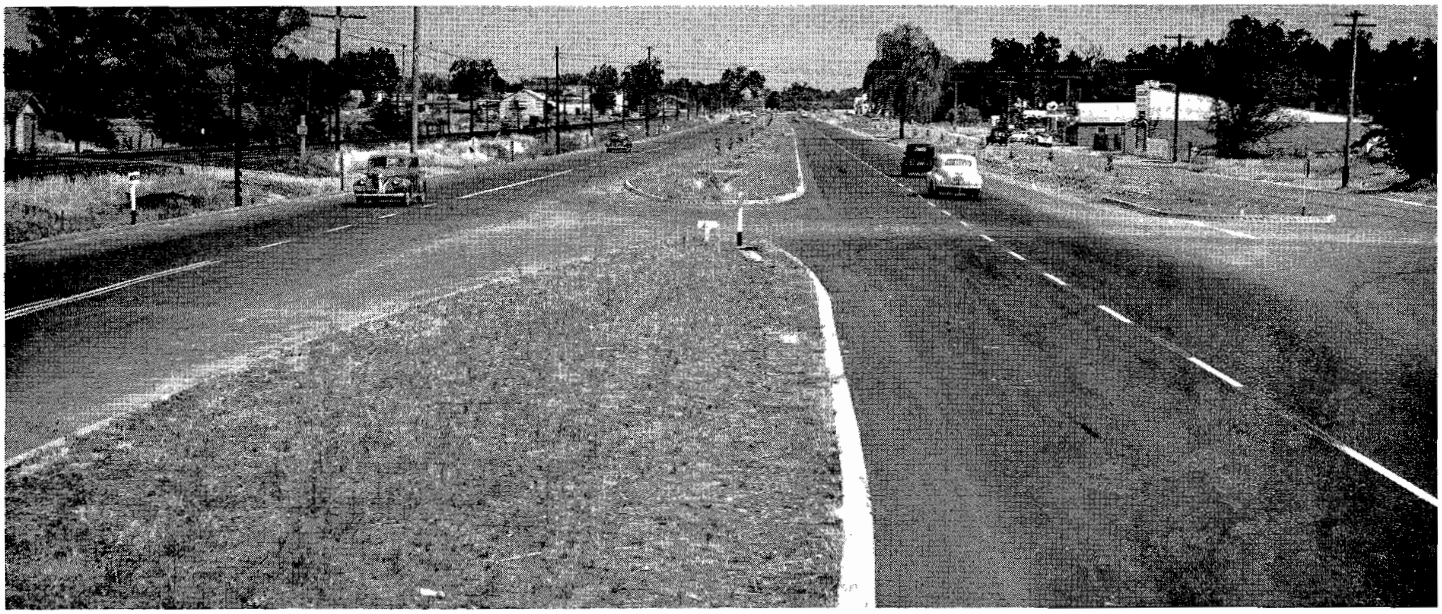
In general, the terrain is level and opportunity for drainage development poor.

Seepage From Canal

Approximately paralleling the highway project for its entire length is the main canal of the Anderson-Cottonwood Irrigation District. This canal lies

Completed section of new freeway in Anderson. Frontage road on left



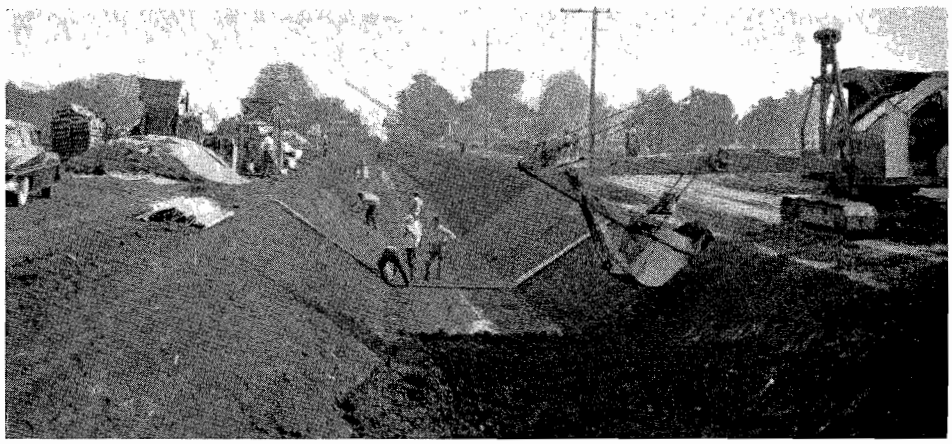


This is another completed section of the freeway in Anderson looking south, with frontage road on right

on higher ground than the highway and consists of an unlined channel, substantial portions being uncompacted embankment sections.

The resulting seepage from the canal during the irrigating period that extends from April to November saturates the adjoining land to the extent that, during construction operations, the water table was encountered in the subgrade one to two feet below the natural ground surface.

In addition, irrigation runoff from the abutting ranches, which was formerly handled by an intercepting ditch westerly of the old highway, flooded grading operations at a time of year when ideal ground conditions for grading are normally anticipated.

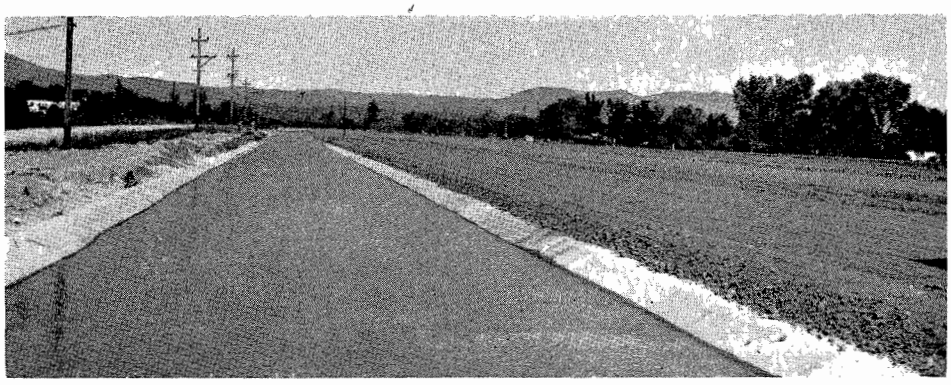


Irrigation canal under construction

Drainage System

The result was that a greatly expanded drainage system had to be provided and subdrains placed longitudinally under the roadbed through many sections to protect the newly constructed highway. A total of 9,700 lineal feet of subdrains, ranging from 12 to 24 inches in diameter, was placed to draw off ground water from the subgrade.

Irrigation canal completed



The southerly portion of the contract lies in the Town of Anderson; in this vicinity, for a length of 3,000 feet, has been constructed a limited-access freeway.

On the east the highway is paralleled by the Southern Pacific Railroad.

Seven business blocks fronted the existing highway on the west side, four of which were highly developed.

Through these seven blocks a limited-access highway was constructed which provided two lanes for northbound and two lanes for southbound traffic with eight-foot emergency parking shoulders.

. . . Continued on page 49

U.S. Job

Improvement of U. S. 50 From Meyers to Mays in Lake Tahoe Area Under Way

PROJECT California Forest Highway 32-L, Placerville - Lake Tahoe, now under way, covers the construction to modern standards of a part of U. S. Highway 50, a main transcontinental highway. The project begins about ¾ mile west of Meyers, California, at the foot of the recently completed "Meyers Grade" and extends in a northerly direction approximately 5.0 miles to Mays, commonly known as Tahoe Valley Wye.

The proposed improvement consists of grading, placing 4-inch compacted base course, and 3-inch compacted bituminous plant-mix surfacing with flush seal coat. The roadbed is being surfaced to a width of 32 feet which will provide two 11-foot traffic lanes and 5-foot shoulders. Location survey for the project was made during the summer of 1944. The alignment for the new highway traverses relatively easy, flat to rolling terrain permitting high standards for alignment and grades. Minimum radius curve is 900 feet and maximum grade is 5 percent. Minimum nonpassing sight distance is 370 feet. These standards will permit safety at normal maximum driving speeds.

Under joint agreement between the California State Highway Department, U. S. Forest Service, and U. S. Bureau of Public Roads, funds for the construction of the project were programed from Fiscal Year 1951 Federal Forest Highway funds. The project was advertised by the Bureau of Public Roads on April 17, 1950. Bids were opened on May 9, 1950. Six bids were received ranging from the low bid of $148,801.40 submitted by Harms Brothers, contracting firm from Sacramento, to a high bid of $212,928. The contract for construction of the project was awarded to Harms Bros. and contract time began on May 23, 1950. Work in progress at present consists of clearing and some grading work. It is expected that the contractor will complete the contract during the 1950 season. Construction work is under the supervision of Chas. C. Morris, Division Engineer, Bureau of Public Roads, U. S. Department of Commerce. W. H. Baugh, Public Roads' engineer, is resident engineer on the project.

Construction is under way for the improvement of U. S. 50 from the foot of Meyers Grade to Mays, a cooperative project of the U. S. Forest Service, U. S. Bureau of Public Roads, and State Division of Highways. Lower photo shows existing highway on left, realignment on right

The improvement of the Meyers to Mays section of the Placerville-Lake Tahoe road will replace a low standard hazardous section approaching Lake Tahoe which carries heavy traffic particularly during the summer months not only from transcontinental travel but from local residents in the Tahoe Valley Lake area.

Hollywood

Continued from page 18 . . .

geles Times and his photograph of this event is reproduced.

When these two contracts, as described in this issue by the two resident engineers, have been completed as anticipated in December of this year, it will be possible to open the Hollywood Freeway to public traffic for a distance of 3½ miles between Grand Avenue and Silver Lake Boulevard. When this is done, public traffic will then be utilizing the highest level of the four-level grade separation structure. Other levels of this bridge will come into use later as future connecting construction with the Arroyo Seco Freeway and the Harbor Freeway is carried out.

Freeway Law

Continued from page 33 . . .

solely from traffic regulation under police power."

After reviewing cases submitted by the plaintiffs in support of their contention, the appellate court, speaking through Associate Justice Mussell, distinguished them from the Bakersfield situation in the following language:

"In all of the foregoing cases in which it was held that compensation must be paid there was either physical injury to an owner's property itself, as in the *Reardon* case, or a physical impairment of access from the property to the street, whether caused by change of grade, as in the *Eachus* cases and the *Rockridge* case, or by physical impairment of the property to the street by the means of the construction of a physical barrier as in the *McCandless* case, or by removing the property from the through highway and placing it on a side or service road as in the *Ricciardi* case, or by the creation of a dead end street as in the *Bacich* case. None of these cases involve the division of a highway into separate roadways by concrete islands or division strips and all are factually different from the case at bar. In this connection, it should be noted that the rule that reasonable modes of egress and ingress embrace access to the next intersecting street as announced in the *Bacich* case, supra, is not applicable here for plaintiffs have access to Brundage Lane, the next intersection to the south, and to First Street on the north, adjoining their property."

The only previous California decision wherein the facts were found by the Fourth District Court to be comparable to the Bakersfield situation was the case of *Beckham* v. *City of Stockton*, 64 Cal. App. 2d 487. The subway therein involved, the court said, "acted, in effect," as the State had contended, "as a center dividing barrier and necessitated a certain amount of additional travel * * * from plaintiffs' properties."

Presiding Justice Adams of the Third District Court, in her opinion in the *Beckham* case, had held that this constituted "mere inconvenience and circuity of travel" and constituted "no grounds for the recovery of damages." This holding Justice Mussell cited as supporting his opinion that the center barrier at Bakersfield constituted no actionable damage.

"The facts alleged in the instant action," Justice Mussell said, "indicate that the real basis of plaintiffs' claim is diversion of traffic from their business." However, the applicable rule is, he said, quoting from *Rose* v. *State of California*, 19 Cal. 2d 713, 737:

"The damage suffered by plaintiffs is, as we have seen, the interference with their right of access. The diversion of traffic is not a proper element to be considered in computing those damages inasmuch as a landowner has no property right in the continuation or maintenance of the flow of traffic past his property."

"It seems quite clear," the justice continued, "that the division of a highway is an exercise of the police power being directly intended for the public safety." And he went on to point out that "damages resulting from the exercise of police power are not compensable," citing *Simpson* v. *City of Los Angeles*, 4 Cal. 2d 60.

"Statutory authority for a center division strip, such as that under consideration in this case," he said, "is found in Section 144 of the Streets and Highways Code. Under that section the State Highway Engineer is authorized to divide or separate any state highway into separate roadways whenever there is particular danger to the traveling public of collision between vehicles proceeding in opposite directions or from cross traffic by constructing curbs, central dividing sections or other physical separations, or by signs, marks or other devices in or on the roadway appropriate to designate the dividing line."

Statements of Mr. Justice Edmonds and Mr. Justice Traynor in the *Bacich* case, 23 Cal. 2d 343, were quoted in further support of the conclusion that the Bakersfield situation involved only an exercise of the police power and, as such, was not actionable.

The court disposed of the question of the plaintiffs' access to their property with this statement:

"The facts pleaded herein show that the highway upon which plaintiffs' property abuts is not closed and that plaintiffs, once on the highway to which they have free access, are in the same position and subject to the same police power regulations as every other member of the traveling public. Because of a police power regulation for the safety of traffic, they are, like all other travelers, subject to traffic regulations. They are liable to some circuity of travel in going from their property in a northerly direction. They are not inconvenienced whatever when traveling in a southerly direction from their property. The rerouting or diversion of traffic is a police power regulation and the incidental result of a lawful act and not the taking or damaging of a property right."

Center Strip Upheld as Safety Regulation

The court then concluded that "If the contention of the plaintiffs herein is sustained, the right of the State to control the traffic as a safety regulation would be definitely curtailed and traffic islands or double lines in the highway to separate through traffic would be prohibited. The damage of which plaintiffs complain would be the same if no division strip had been constructed on the highway in question but that double white lines had been painted on the highway and a 'no left turn' sign had been erected, or if the entire highway had been designated as a one-way street.

"We conclude, therefore, that the plaintiffs failed to state a cause of action in their amended complaint and the judgment is, therefore, affirmed."

Mr. Robert E. Reed, presently Chief Counsel for the department, argued the case before both the superior court and the district court of appeal, and Mr. Harry S. Fenton, of the legal staff, did work on the brief.

The importance of the decision of the district court in *Holman* v. *State*, will be more fully indicated as the highway program progresses. The right of the public to provide for safety on its streets and highways and to regulate traffic by the placing of physical barriers within streets and highways, as authorized by existing legislation, is, of course, fully validated. Ordinances

. . . Continued on page 54

Something New

Bridge Department Develops Portable Pile Testing Rig

By G. C. SMITH, Associate Bridge Engineer

IN ORDER that a quick economical method of making load tests on piles might be had the Bridge Department of the Division of Highways developed a convenient lightweight testing apparatus. The new equipment, already successfully used on several other jobs, was recently used to make load tests on some drilled-in piles in the Imperial Valley.

Eighteen reinforced concrete slab bridges were being built on Route 187 which follows up the east shore of the Salton Sea.

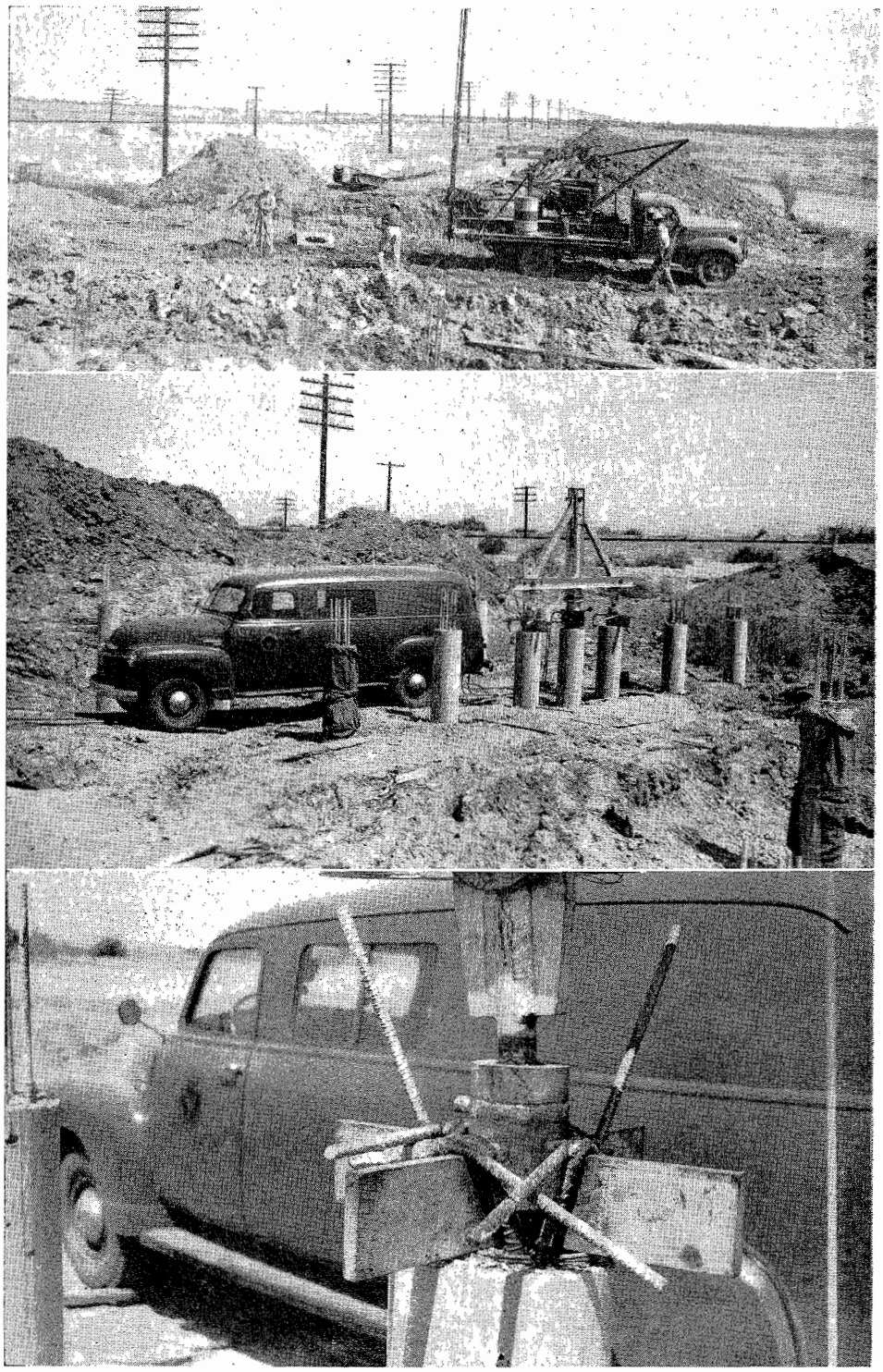
All of the bridges were founded on drilled-in piles consisting of reinforced concrete columns poured in 14-inch diameter holes drilled in the ground. The foundation in this locality was suited admirably to this system and the holes stood perfectly after drilling.

NEW TECHNIQUE

This technique represented a definite departure from piles previously used by the Bridge Department. No pile driving was done. The only equipment necessary was that used in drilling the holes. This consisted of a truck-mounted gasoline-powered auger-type earth drill capable of drilling holes to a depth of about 22 feet. All piles penetrated at least 15 feet below channel grade. Standard reinforcing for cast-in-place piles was used throughout. Pile extensions were poured in 14-inch diameter steel forms which extended from the ground line to the cap. The design load is 20 tons per pile.

To determine the actual load-carrying capacity of these piles, two load tests were made with the new equipment.

At two sites, one where the specified pile penetration was 20 feet below channel grade, the other, where penetration was 15 feet, two additional piles to be test loaded were drilled and poured, each midway between two plan piles. The test piles were reinforced similar to plan piles. However, the two piles on either side of the test piles, used as anchors for the jacking truss, were each additionally reinforced

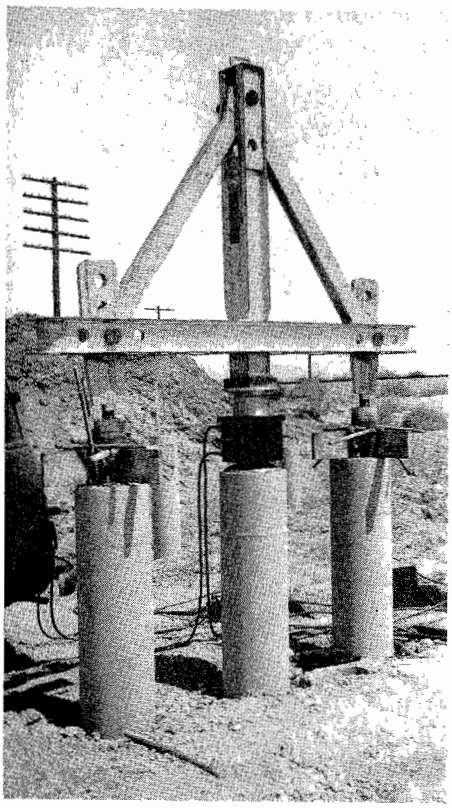


UPPER—Pipe drilling rig in operation. CENTER—Detail at anchor piles. LOWER—Test load apparatus. Truss and jack in place

with four 1-inch bars. These bars extended from the tips of the piles to approximately 2 feet above cut-off. The protruding bars were bent over and around the fins of the truss base and welded one to another.

LOAD TESTING EQUIPMENT

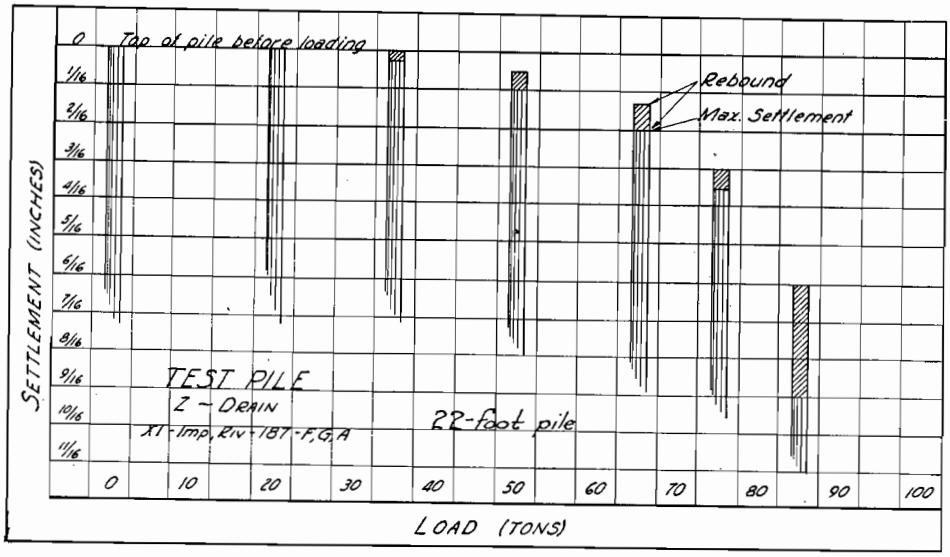
The pile load testing equipment was operated by Bridge Department personnel. This equipment consists of (1) a pin-connected steel truss which is used to transfer reaction loads to the two anchor piles; (2) a hydraulic power unit; and (3) a 115-ton capacity hydraulic jack. Details of the truss are shown in the accompanying photograph.



Truss and hydraulic jack on test pile

The hydraulic power unit is a self-contained high-pressure constant-pressure system designed for field use and powered by a 5-kw. gas engine driven generator. A 3-h.p. motor geared to give a shaft output of 270 rpm is directly connected to a rotary piston type hydraulic pump capable of a maximum pressure output of 3,000 psi. Discharge from the pump is piped to a manifold. Connected to the manifold are:

1. A 3,000 psi nitrogen loaded accumulator cell which is preloaded to 1,000 psi.



Settlement and rebound, Z-Drain

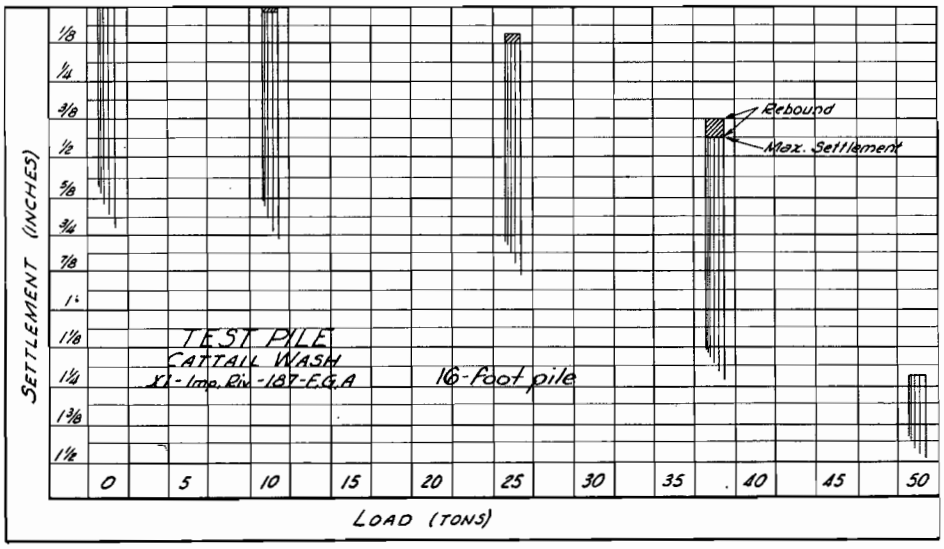
2. A close pressure differential mercury switch.
3. A 4,000 psi gage.
4. A 3,500 psi overload relief valve containing a relief valve port leading back to a reservoir tank.
5. Pressure outlet lines leading to a 4-way control valve by which pressure may be diverted to either side of the piston of the double acting 115-ton hydraulic pressure cell.

CONSTANT LOAD MAINTAINED

The purpose of the nitrogen loaded accumulator is to maintain a constant load even though slight pile settlement occurs. This enables the equipment to be brought to proper load and left without constant attention to maintain an even hydraulic pressure at the loading cell. The pressure switch may be adjusted to hold the pressure within a 150-pound range. The maximum pressure that may be developed through the mercury switch is 2,500 psi. Two level gages are mounted on the power unit to insure leveling of the mercury switch. The 4,000 psi gage is used as a cross-check on the mercury switch and for setting the switch accurately. A needle valve with a lead-off line is incorporated in the 3,500 psi overload relief valve and is used for controlling pressures between 0 and 1,000 psi.

The 115-ton pressure cell is a double-acting hydraulic jack having a 103.87-square-inch piston area and a 4-inch stroke. The barrel and main base of the cell are steel; the piston lock-ring, and

Settlement and rebound, Cattail Wash



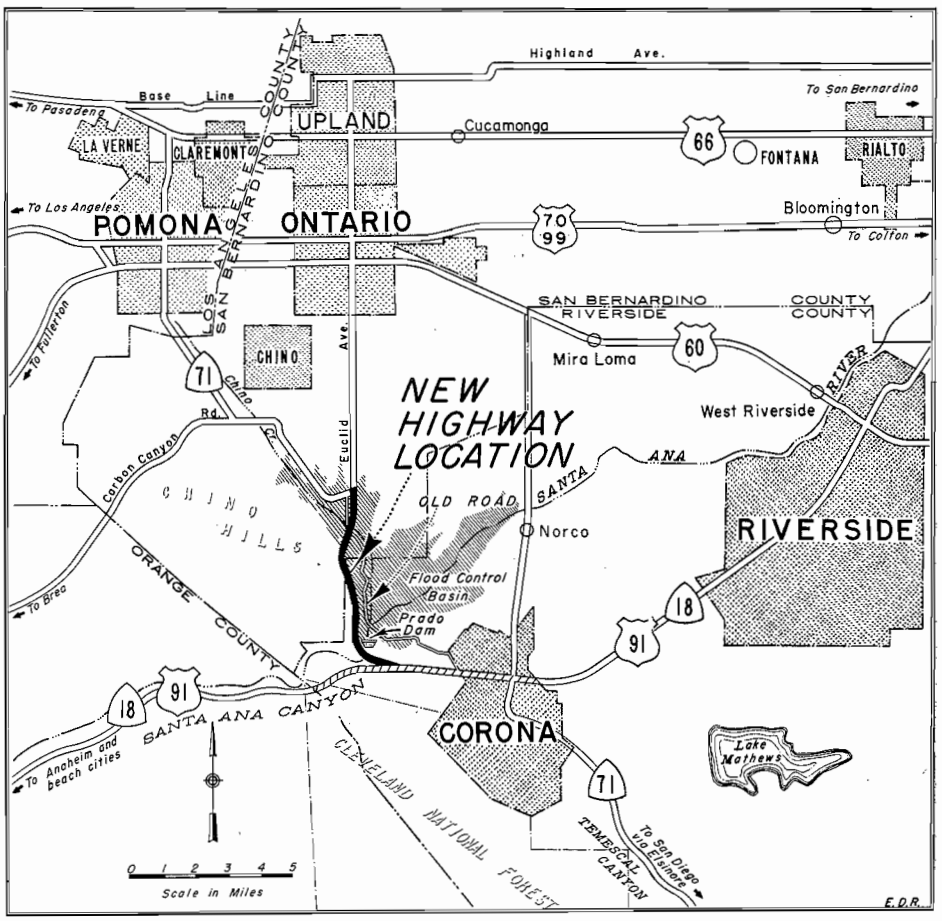
Prado Dam

A New Highway and Six Bridges Will Soon Be Open on Historical Route

IF YOU DRIVE along State Sign Route 71 in August, approaching Corona you will follow a winding roadway down into the bottomlands of the Prado Flood Control Basin. The road is narrow and you can't see very far around the curves. The crest of Prado Dam stands high above you.

But when you take the same trip next September, you will guide your car over the sweeping curves of a new Highway 71. You will feel the security of adequate width and a view of the road ahead. And as you glide around the west end of Prado Dam you will see that you are overlooking the crest of that great earthfill structure, and are high above the old road.

For September will bring the opening to traffic of a 6½-mile relocation project on Highway 71 in Riverside and San Bernardino Counties. The new route extends from Euclid Avenue at Pine Avenue to a junction with Highway 18-91 west of Corona.



Flood Waters Controlled

The story of Prado Dam is the story behind this highway relocation. For it was the construction of the dam that made it necessary to move the highway away from its present location in the bottom of the flood basin where the road is subject to inundation by even the smallest flood flows.

The dam retards the flood waters of the Santa Ana River so that they can never again bring staggering devastation to downstream Orange County. It is strictly a flood control structure and, as may be observed in the accompanying photographs, the basin contains no water during times of ordinary stream flow. The U. S. Corps of Engineers constructed Prado Dam and brought it to completion just prior to World War II.

Removal of the highway from the lowlands of the basin was not accomplished immediately after the dam completion due to the intervention of the war. After the conflict ended, planning for the project was resumed. Extensive negotiations with the Corps of Engineers were required in order to determine the government's share in the cost of the highway location. The final contract entered into by the Corps of Engineers, Riverside County, San Bernardino County, and the State provided that the United States would pay $650,000 toward the cost of the work. The remaining cost will be paid from state highway-user funds.

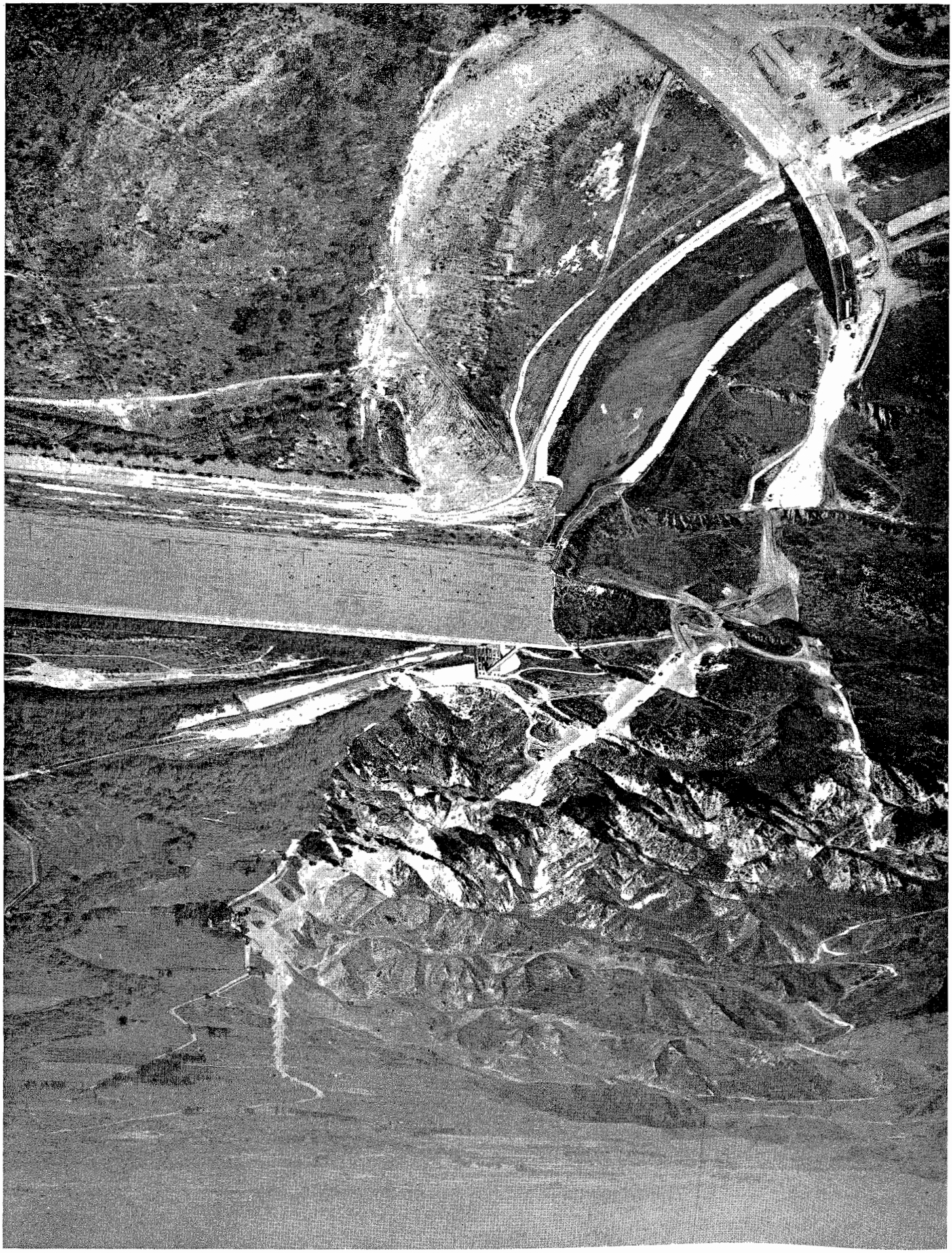
Early California Trail

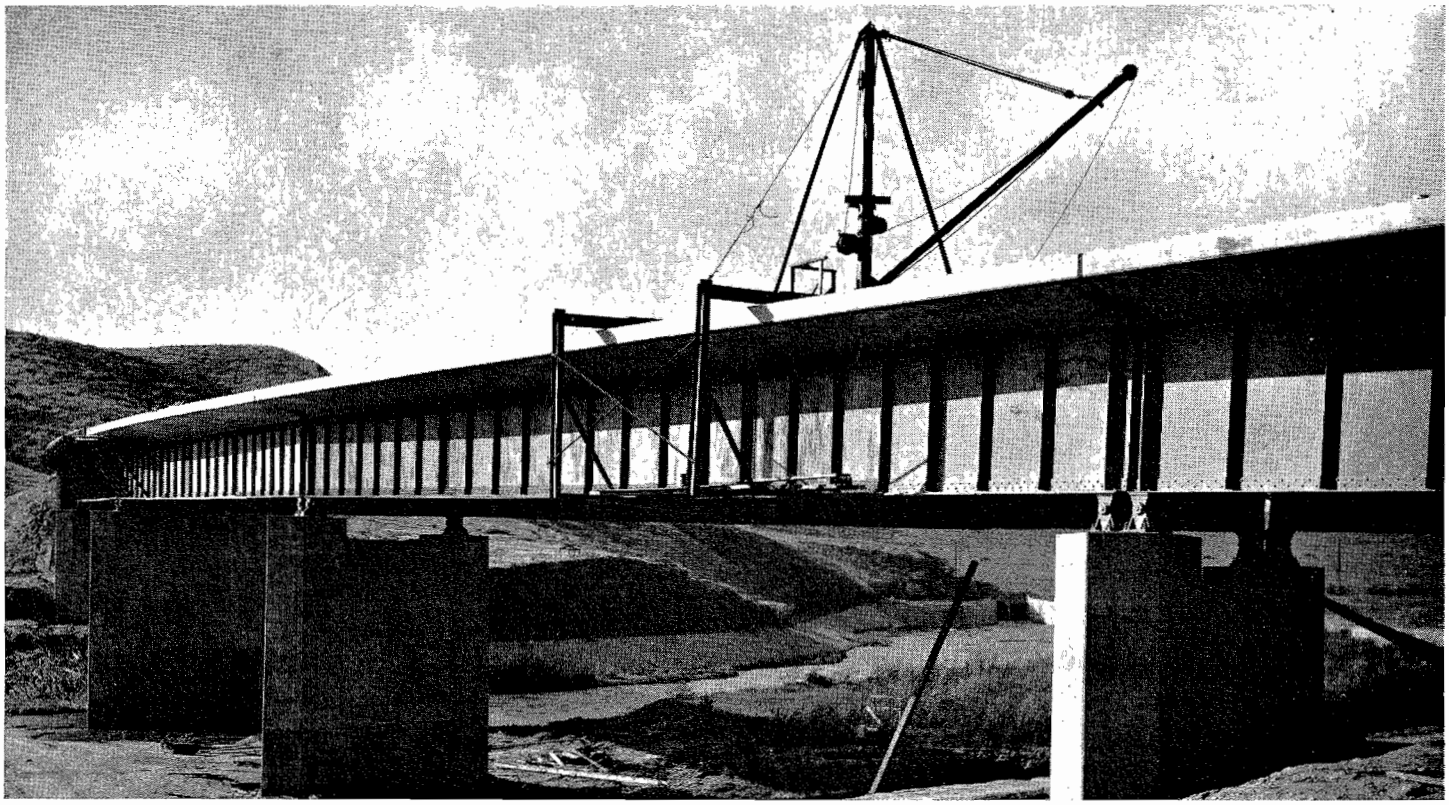
Although Prado Dam will catch your eye as you drive the new road you will also be interested in reflecting that the general routing of the highway follows a trail whose origin is in early California history. For this was the way of the Colorado Road, a pioneer all-year route into California from the east.

This old trail connected Los Angeles with Fort Yuma on the Colorado River. It came north through Temescal Canyon past the site of the present city of Corona and after crossing the Santa Ana River ran along the base of the Chino Hills and up Chino Creek to Rancho Chino.

The Colorado Road gained national importance when the Butterfield Company's stages used it in hauling mail between St. Louis and San Francisco

Aerial view looking northerly along the relocation of State Sign Route 71 around Prado Dam and Flood Control Basin. The Santa Ana River Bridge is in the left foreground





This is the largest of six bridges being constructed in the relocation of Route 71. It is 495 feet long and crosses the Santa Ana River just below the outlet of Prado Dam. The structural steel girders and concrete deck have been finished and are ready for construction of the railing

from 1858 until the outbreak of the Civil War. On February 8, 1872, this pioneer trail first became part of a highway system when the Board of Supervisors of San Bernardino County declared the "Old Fort Yuma Road" to be a public highway. The present Riverside County was at that time a part of San Bernardino County.

Inland Route

In more recent times this highway has been traditionally known by generations of motorists as the "Inland Route" to San Diego. The project now nearing completion represents another step in its modernization, which has included 55 miles of new highway in San Diego County and southern Riverside County.

The current project provides a two-lane roadway with plant-mixed surfacing on traffic lanes and shoulders. The total roadbed width is 34 feet in the section of heavy cuts and fills and 38 feet in open terrain. Access to the highway is controlled. The major item on the roadway contract is roadway excavation, which totaled 806,000 cubic yards.

CONNECTING IMPROVEMENTS

As you travel south on Route 71 and pass through the interchange at the end of the new Prado Dam highway you will be entering another California thoroughfare whose traffic has outgrown roadway capacity. And you will be pleased to discover that something is being done about it.

As you drive along you will observe that operations have already started on the widening of Highway 18-71-91 between the Riverside-Orange County line and the eastern limits of the City of Corona. To help you identify this section of highway on the map it has been marked by hatching.

West of Corona a new two-lane roadway will be laid beside the present road to produce a four-lane divided expressway. Within the City of Corona, where the way is along Sixth Street, the plans call for widening to provide four traffic lanes and two parking lanes.

Peter Kiewit Sons Co., Arcadia, is the contractor for the westerly project and E. L. Yeager, Riverside, is the contractor for widening in Corona.

An outstanding feature of the project is the interchange with Highway 18-91. The design provides for full separation of all intersecting traffic movements and includes a four-span steel plate girder separation structure upon which Highway 71 crosses over Highway 18-91. There are three other major structures included in or adjoining the interchange. These are the overpasses of the Atchison, Topeka and Santa Fe Railway on both the main highway and the northwest ramp connecting the two highways, and a bridge to carry the ramp across Oakwing Creek.

Bridge Contracts

Two other bridges have been constructed—across the Santa Ana River and Chino Creek. The Santa Ana River structure is the largest on the project, being a five-span plate girder bridge 495 feet long. The three central spans measure 120 feet each.

The construction on Route 71 is being accomplished under two contracts. The contractor for the roadway work and for Chino Creek Bridge is A. Teichert and Son, Inc. of Sacramento.

It is estimated that final cost under the roadway contract will be approximately $640,000. The contractor's superintendent is Robert T. Skinner. Resident Engineer Kent B. Stone and Bridge Department Representative Samuel S. Dulberg are representing the State on this contract.

The bridge over the Santa Ana River and the four bridges in the interchange area are being built by R. M. Price Co. and O. B. Pierson of Altadena under a contract which will total approximately $480,000. Mr. Pierson is superintending the construction operations. Mr. W. H. Johnson is Resident Engineer for the State on the bridge contract.

An incidental feature of this highway project was the relocation of a section of the Texas-to-California 30-inch high-pressure gas line. An article in the January-February 1950 issue of *California Highways and Public Works* told the story of the Southern California Gas Company's operations in moving the big natural gas main in order to clear the way for the highway construction.

Hollywood

Continued from page 19 . . .

paver, a Blaw-Knox spreader, a Blaw-Knox tamping and finishing machine, and a Johnson float were used in the pavement operation. Water for the mixer was furnished from a 5,000-gallon water tank truck pulled by the mixer, this tank being supplied by another water tank truck hauling the water from city domestic supply on the job.

At the present time the paving of outer highways and cul-de-sac streets with asphaltic concrete and plant-mixed surfacing is under way and approximately 30 percent complete. Six-inch cement-treated base and asphalt concrete paving of off and on ramps will be under way shortly.

The estimated date of completion for this $1,358,000 contract is October 1, 1950, or approximately 60 days ahead of contract time.

HIGHWAY CONSTRUCTION COSTS INCREASE

By Richard H. Wilson, Assistant State Highway Engineer, Henry C. McCarty, Office Engineer, and Richard R. Norton, Assistant Office Engineer

This is the fourth in a series of articles on California Highway Construction Costs bringing the information up to date—Editor.

HIGHWAY CONSTRUCTION costs in California, as measured by the California Highway Construction Cost Index, appear to have entered the third major phase in the postwar period with an increase of 12.5 percent in the last three months.

The first phase was the period 1946 to mid 1948 when the index increased 30.5 percent from 166.1 (1940=100) to 216.8. The second phase occurred in the period from mid 1948 through the first quarter of 1950 when the index decreased 26.2 percent from 216.8 to 160.0. The third phase appears to have started in the second quarter of 1950 when the index increased 12.5 percent from 160.0 to 180.0.

Following is a listing of the index since the peak was reached in the first half of 1948:

Period	Index (1940 = 100)	Change from Previous Period	Change from Peak
1948 (1st half)	216.8		
1948 (2nd half)	216.4	—0.2%	—0.2%
1949 (1st qtr.)	200.4	—7.3%	—7.6%
1949 (2nd qtr.)	195.7	—2.3%	—9.7%
1949 (3rd qtr.)	187.9	—4.0%	—13.3%
1949 (4th qtr.)	178.8	—4.8%	—17.5%
1950 (1st qtr.)	160.0	—10.5%	—26.2%
1950 (2nd qtr.	180.0	+12.5%	—17.0%

The reversal of the downward trend in highway construction costs coincides with the same trend in general economic conditions throughout the country. Business activity is at an all-time high, with the construction industry in the forefront, showing an increase in volume of 45 percent for the first five months of 1950 compared to the same period in 1949.

This increase in construction activity has had an inflationary effect on material prices and wage rates. Lumber has risen sharply since the beginning of the year and there was an increase in the price of steel. There has been a general increase of $0.08 per hour for all construction labor in Southern California and an increase of $0.15 per hour for carpenters in the San Francisco Bay area.

The average number of bidders per project has dropped to 5.2 in June 1950, from a high of 10.8 in December 1949, and 6.5 in July 1949.

The war in Korea will undoubtedly have a further inflationary effect on prices and wage rates. The duration of this effect will depend on further world development.

No Parking

Continued from page 43 . . .

parking, show an average increase of about 3½ miles per hour. Congestion has been noticeably lessened by the availability of more lanes.

During 1949 the police department reported 57 accidents on the section involved. One-fourth of all accidents occurring between intersections were directly attributable to parking and others to the absence of a sufficient number of lanes. As this is written, the parking ban has been in effect only one month—too short a time for a reliable "before and after" study. It is encouraging, however, that during that month only one-half as many accidents occurred as during the same month last year.

Since 1941 most property contiguous to Mineral King Avenue has been zoned by the city planning commission as C—1½ (neighborhood commercial with off-street parking). Several new enterprises have gone into business and provided the required parking lots. As curb space was not at a premium, however, most of their customers continued to park at the curb.

. . . *Continued on page 60*

R. E. Ward Retires After 38 Years With the Division of Highways

AFTER 38 years of continuous state service, R. E. "Ernie" Ward, Associate Highway Engineer, District II of the Division of Highways, retired on May 1, 1950. Numerous fellow employees attended a dinner at the Redding Golf and Country Club on the evening of April 27th to honor him and Mrs. Ward upon the occasion of his retirement.

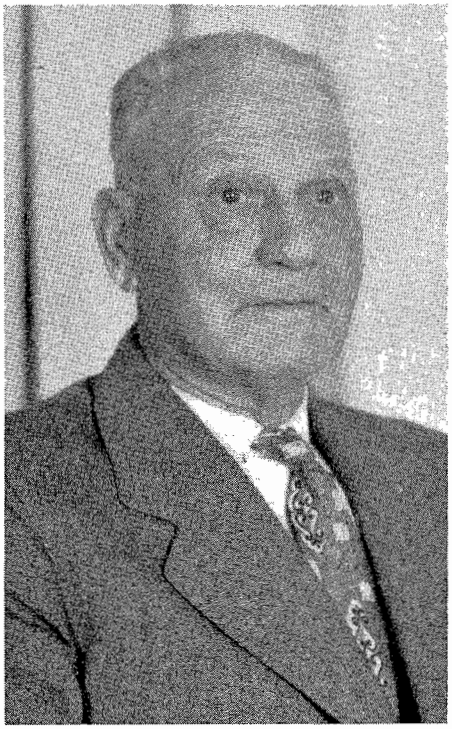
Mr. Ward began his engineering career in 1908 on railroad surveys between San Diego and Yuma and later on irrigation surveys in the Imperial Valley. His first work on roads was for San Diego County in 1911, where he was associated with A. B. Fletcher, T. A. Bedford, R. S. Stalnaker and H. S. Comly, all familiar names in the Division of Highways.

On April 23, 1912, shortly after the California Highway Commission was organized, he went to work for the State as transitman on surveys for Highway 99 north of Redding in the vicinity of Pit River. H. S. Comly was chief of party and T. A. Bedford was district engineer. He became chief of party in 1914, and had a part in the location of many roads in District II.

Surveying in those days was a rugged business, particularly in the rugged mountains and canyons that comprise a good portion of District II. Teams and wagons were used if there was an existing road of any kind, but in many locations, such as the Trinity River, no roads existed and transportation was by foot or horseback, and supplies were hauled by pack train. A chief of party had considerable more to do than just survey; camps had to be established, cooks hired, food ordered and horses cared for. Ernie can tell many tales of the good old days.

In 1916 he was assigned as resident engineer in the first prison road camp in District II at Round Mountain west of Redding.

During the years from 1916 to 1942 he alternated as Chief of Party and resident engineer, locating and constructing many miles of highway in Northern California. In 1928 he was surveying in the rugged Feather River Canyon, and in 1934 he became resident engineer of a prison road camp established to construct a portion of the Feather River Highway.



R. E. Ward

From 1942 until his retirement this year he has held the post of right of way engineer for the District II right of way department.

Freeway Law

Continued from page 46 . . .

prohibiting left-hand turns or U turns, and schemes for handling traffic by systems of one-way streets, may not now be subject to attack on legal grounds.

It seems evident, also, that the language used by the Supreme Court in *People* v. *Ricciardi*, 23 Cal. (2d) 390, with respect to "direct access to the through traffic highway" is not construed by the district court to mean that an abutter's right of access extends, as has been contended, from his property directly across the street or highway, for the full width thereof. Access is satisfied if he may proceed from his property to one of the through traffic lanes of the highway.

Holloway v. *Purcell* and *Holman* v. *State of California*, one may be so bold as to predict, will stand as leading cases in the development of the highway law of California. The opinions in these cases take cognizance of existing conditions respecting traffic on our streets and highways and the efforts of the State to provide facilities that will be more nearly adequate for the expanding motor vehicle economy of California. They are a reassurance to the California Highway Commission and the Department of Public Works as they face the herculean task of the modernization of the California Highway System.

In Memoriam

RUTH K. DUNN

Ruth K. Dunn, a member of the Maintenance Department in the District VII Division of Highways organization, passed away May 21, 1950, at the Queen of the Angels Hospital in Los Angeles.

Mrs. Dunn first entered state service in 1929 and was an employee of the Maintenance Department in Los Angeles since 1931. The position she held at the time of her death was that of Supervising Clerk, she being in charge of the stenographic staff of the Maintenance Department and also acting as secretary to the District Maintenance Engineer.

Mrs. Dunn was very devoted to her work and although she had been in ill health for quite some time she reported daily to her office and carried on the duties of the position up to within two weeks of her death. She was an outstanding employee. She had an enthusiastic and sincere loyalty for the State Division of Highways organization and particularly for her own department, the District VII Maintenance Department. The high morale of this unit was due in no small part to her.

She was an active member of the Barbara Stanwick Chapter of Athena Sorority and her hobby was her garden as she derived much pleasure from beautiful flowers.

Mrs. Dunn's many friends in the Division of Highways and throughout the State deeply regret her passing.

State Fair

Continued from page 24 . . .

standards of the three sections which make up this 10 miles is scheduled for this year. It enters the city over the Tower Bridge across the Sacramento River.

North Sacramento Freeway

U. S. 44-99W from the east and north enters Sacramento by way of the North Sacramento Freeway, one of California's most modern highway developments of the freeway type, with all cross-traffic eliminated from the divided roadways by means of grade separation structures. This route enters the city proper over the 16th Street Bridge across the American River.

The other seven routes are all two- or three-lane highways in their approach to the city.

Of greatest present interest in state highway development at Sacramento is the proposed relocation of State Route 98 with a crossing of the American River near Elvas Junction. As the first tangible step in advancing this proposed relocation, the State will award a contract this year for construction of the substructure for the new bridge at Elvas Junction. At the same time an intensified program for right of way acquisition for the proposed route is being pursued by the State.

As the Division of Highways, Department of Public Works, carries out plans to expand highway facilities serving Sacramento, the fair has perfected its own plans of staging its greatest exposition to date.

Features of Fair

There will be magnificent night entertainment spectacles, with a dazzling ice revue to be presented the first five nights; stars of stage, screen and radio will appear on subsequent nights. There will be the thrilling Sunday motorboat races on the newly-constructed fair grounds race course, the swank horse show, the beautiful flower show, the important art show, the brilliant Pageant of California Fashions, the great livestock shows, the dynamic county and foreign exhibits, the International Wine Show, hobby and food shows, a dairy show, the splendid horse racing program, the manifold exhibits of the women folk and great displays of farm machinery and household articles of infinite variety.

One of the most interesting and unique new events to be staged at the fair will be the truck rodeo. Drivers of massive trucks, with trailers attached, will demonstrate their skill in manipulating their huge machines through a road maze of tight corners and other difficult situations. The truck rodeo, one of the many free attractions provided by the fair, will be held on the parade grounds on the eastern side of the 207-acre fair site.

General admission to the fair remains the same low 50 cents, including tax, with children under 12 admitted free.

For 11 glorious days and nights the State Fair will show California on parade, with a multitude of exhibits reflecting the ever-expanding economy of a mighty commonwealth, which is a leader in agriculture, industry and trade.

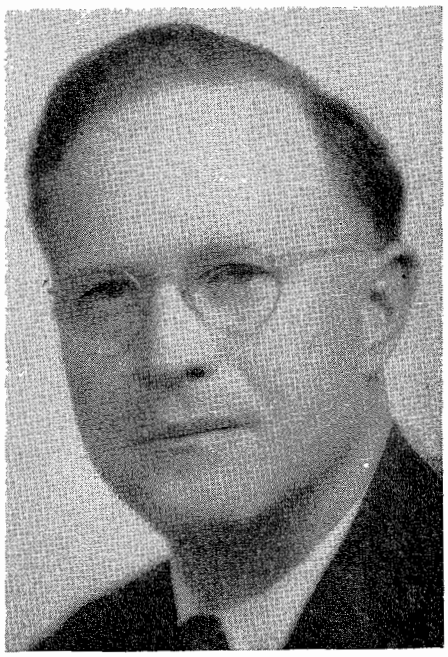
Ira G. Thomas Retires To Enjoy Rest

After almost 33 years of state service, Ira G. Thomas retired on July 19, 1950.

Mr. Thomas went to work for the Division of Highways in District V in San Luis Obispo on November 1, 1917. From District V, where he worked up to the position of District Office Engineer, he went to District I at Willits and Eureka as District Office Engineer. He moved to San Diego as District Office Engineer when District XI was organized in 1933. In 1935 he was transferred to Sacramento as Assistant Engineer in the Department of City and Cooperative Projects where he served for the last 15 years.

Born in Iola, Kansas, July 19, 1889, Mr. Thomas went to South Pasadena, California, in 1903 and graduated from South Pasadena High School in 1909. He attended the University of Southern California for one year and then entered the University of California at Berkeley, graduating with B.S. in Civil Engineering in 1914. He was married to Bessie E. Dashiell of Berkeley September 5, 1914. The couple has two daughters, Betty Lou and Merle Ellen, both of whom are married.

After graduation, Mr. Thomas was employed by the Los Angeles County Road Department as draftsman and Resident Engineer until July, 1917, when he became a bridge designer for Ventura County, accepting in the same year a position with the California Highway Commission.



Ira G. Thomas

Mr. and Mrs. Thomas plan an extensive trip encircling the United States, going up the Redwood Highway to Washington, thence east along the northern border with diversions to Lake Louise and Banff and Winnipeg in Canada, thence to Duluth circling around the southern edges of the Great Lakes through Chicago, Detroit, on down the Saint Lawrence to Nova Scotia, south along the eastern seaboard to Florida. While in the south they will take the Caribbean cruise then return to California by the southern route to Los Angeles and back to Sacramento.

A Treatise

Continued from page 13 . . .

finished during the fall of 1948 and received a light bituminous penetration treatment, a few small pot holes had developed and a small amount of raveling had taken place, mostly along the centerline, but in general, the surface was in good condition.

An inspection trip made in February, 1950, showed no significant change from last year and all 11 sections were in good condition with the exception of some light surface raveling referred to above.

For a comparison, areas of untreated bases, located adjacent to the treated sections, which were in good or satisfactory condition during the fall of 1948, failed during the following winter. *See Figure 10.*

Lime stabilization treatment when compared with low cement treatment for bases or subbases, permits greater flexibility during construction as it is not essential that the lime-treated material be compacted soon after mixing. In areas where comparatively inexpensive agricultural lime may be obtained in bulk, a considerable saving may be possible as against other comparable types of treatment. On the basis of the above cost analysis and provided cheap lime were available this saving would amount to approximately $1,300 per mile for a base course 6 inches thick and 20 feet wide.

The work described in this report was initiated by District Engineer C. H. Whitmore of District III with headquarters in Marysville, California, and was carried out under the direction of Maintenance Superintendents T. T. Buell at Truckee and E. Willis at Placerville with C. H. Weeks in direct charge of the Georgetown job.

All tests were performed in the laboratory of the Division of Highways under the direction of T. E. Stanton, Materials and Research Engineer, and F. N. Hveem, Staff Engineer of the Materials and Research Department.

TABLE V

TEST RESULTS OF FIELD SAMPLES

III-ED-93-B

Date sampled	O.M. test No.	Aggr. test No.	Treatment	Sampled		Test results								
						Grading % Pass					PI	R Val	Density weight cu. ft.	Remarks
				From	By	¾	#4	200	5u	1u				
Nov., 1948	U 612	48-5200		Lime from truck	Zube			14						45% Moisture
	U 613	5201	Untreated	Roadbed-Sec. 11	Zube	91	57	27	9	5	7	79	136	Same location
	U 614	5202	Lime added	Roadbed-Sec. 11	Zube	84	31	12	2	1	1	87	135	
	U 615	5203	Untreated	Roadbed-Sec. 11	Zube	80	51	26	10	5	16	71	137	Same location. Only few loads of this material placed
	U 616	5204	Lime added	Roadbed-Sec. 11	Zube	75	44	18	4	2	11	79	136	
	U 617	5205	Untreated	Roadbed-Sec. 11	Zube	91	60	28	10	5	7	77	134	Same location
	U 618	5206	Lime added	Roadbed-Sec. 11	Zube	91	61	24	5	2	5	82	131	
	U 619		Lime added	Roadbed-Sec. 6	Zube	78	52	20	4	2	NP	85	125	
April, 1949	U 1046	49-2415	Lime treated	Roadbed-Sec. 2	Zube						NP	81		
	1047	2416	Lime treated	Roadbed-Sec. 5	Zube						NP	91		
	1048	2417	Lime treated	Roadbed-Sec. 6	Zube						NP	82		
	1049	2418	Lime treated	Roadbed-Sec. 11	Zube						NP	86		

Richard H. Wilson on A. S. C. E. Committee

RICHARD H. WILSON, Assistant State Highway Engineer in charge of Administration, has been appointed as a member of the Committee on Developments in Highway Engineering and Construction of the American Society of Civil Engineers.

From the point of view of the engineer practicing in the highway field, this national committee on developments in highway activities is one of the most important of the standing committees of the American Society of Civil Engineers. The appointment of Mr. Wilson to this nine-man committee, which is nation-wide in its scope, is a signal recognition of the preeminent position held by the California Division of Highways and its engineering staff in highway affairs.

The function of this committee is to keep the membership of the American Society of Civil Engineers informed of developments on all phases in highway engineering, economics, and construction and to point out gaps in highway science that should be filled. A further function, when such a discrepancy is uncovered, is to draft recommendations for action to be taken.

Members of this committee are appointed for three-year terms; the Chairman is Mr. A. N. Carter, Manager of the Highway Division of the Associated General Contractors of America, and the Secretary is Mr. Joseph Barnett of the Bureau of Public Roads.

Of the nine members, Mr. Wilson is the only representative from the West.

Another Loss

Continued from page 16 . . .

years have seen the development of heavily traveled freeways in the metropolitan portion of District VIII.

Building Freeways

"In this portion of District VIII, we have been busy during the past several years converting old main routes into freeways, and constructing new freeways. There are a number of freeway projects now under contract. These freeways now total approximately 90 miles in District VIII. Plans for approximately 30 additional miles of freeway are nearing completion.

"The principal mountain recreational area of Southern California is in District VIII. The mountains are extremely rugged and wooded in the high elevations. The famous resorts of Big Bear Lake and Lake Arrowhead are in this recreational area.

"During the earlier years of District VIII we constructed a high standard mountain road via Waterman Canyon into this recreational area. Since the foot of the grade is only 60 miles from the center of the City of Los Angeles, this road had long had overwhelming traffic. To relieve this condition, a new, much higher standard mountain road is being constructed into this mountain area via City Creek. It is all completed, or under contract.

Desert Roads Specialty

"My professional specialty has been the development of desert highways surfaced with light bituminous pavements and a full 27-year study of the movement of wind-borne sand and dust as it affects highways and drainage areas. As the years have gone by various papers I have written for magazines and engineering journals have resulted in extensive correspondence with engineers of foreign countries on the subject of the movement of wind-borne sand and dust.

"In conclusion, I have enjoyed my work with the State enormously. We have had a series of wonderful Chief Engineers. They have all been splendid leaders: A. B. Fletcher, R. M. Morton, Charles H. Purcell, and George T. McCoy. They have all seemed to me to be dear personal friends. It is a true sign of leadership for the superior officer to appear in this light to the subordinate. I have had several offers to leave the state service at greatly increased compensation, but have never been really tempted to do so. I am extremely happy that I have stayed with the State during all the years.

Praise for Stanton

"In listing Chief Engineers, Mr. T. E. Stanton should, in my opinion, be listed between Mr. Fletcher and Mr. Morton as one of our truly great chiefs. During the latter part of the administration of Chief Engineer Fletcher, Tom Stanton, now Materials and Research Engineer, was in fact "Acting" Chief Engineer. Mr. Fletcher's duties had been extended to include other fields and Mr. Stanton had taken over much of the highway administrative responsibility of Mr. Fletcher.

"I have never felt that Mr. Stanton received proper credit for his fine handling of these duties during a period when the department was under extreme criticism. Mr. Stanton continued as Assistant State Highway Engineer for a time under Mr. Morton and then took over the duties of Materials and Research Engineer. He organized the very wonderful laboratory that is recognized throughout the entire Nation as second to none. His department has made possible the standardizing of specifications and much of the universal high quality of construction is due to the Materials and Research Laboratory.

"When I was considered for district engineer, I was instructed to report to Mr. Stanton in Sacramento (though Mr. Morton had already been appointed chief engineer and actually promoted me to district engineer). I recall that Mr. Stanton thoroughly questioned me, and it is my feeling that his recommendation to Mr. Morton had great weight in my promotion to District Engineer for District VIII. During the time Mr. Stanton was in fact administrative "acting" head of the Division of Highways, he introduced reforms in the engineering organization throughout the State that have been of inestimateable value to California in raising the quality of work. These reforms included the protecting of the civil service status of employees and laying the groundwork in extending the merit system in the Division of Highways.

"Upon retirement, I will open a consulting office in San Bernardino at 107 East Highland Avenue, but will not do this until I have had a few months rest. I expect to spend the remainder of my life in San Bernardino, though I have a home also at Balboa where I will spend week ends and vacations.

"I belong to the following organizations: Member, American Society of Civil Engineers; member, American Association of Engineers; Rotary Club."

High Praise

E. Q. Sullivan, State Highway Engineer with headquarters in San Bernardino, who is finishing his distinguished 36-year career with the State Division of Highways this coming August, is well known in the Pomona area. Ever since 1923 he has been the Chief Engineer of District 8, which embraces San Bernardino County and the western portion of Riverside County. During this period of time he has supervised highway work costing an estimated $75,000,000.

Sullivan's retirement follows closely that of S. V. Cortelyou, who was Chief Engineer of the Los Angeles Division, District VII of the State Highway System. Both men are not only high type engineers but men of sterling qualities of character. Their reputation is nationwide. No better highway engineers are to be found in the United States than Cortelyou and Sullivan, and their retirement means a great loss to the State.

The roads that these men have built are lasting monuments to their ability and their knowledge of the needs of the areas which these roads serve.

The Progress-Bulletin, Pomona

IT'S UP TO YOU

California's modernized highways are being engineered for safety, but safe driving remains the responsibility of the individual motorist. When you drive the new highways, keep alert and keep speed under control at all times.

Grading Chalk Hill—1913 methods

El Camino Real

Continued from page 29 . . .

with an espalier of outside plumbing on the side, but otherwise as it was in its heyday as shown in the accompanying photograph taken in 1887, furnished through the courtesy of Mr. Sam Hayes, one of the present owners.

Pioneer Landmark

This old landmark is still in the ownership of the heirs of Cecil Haig, the scion of a prominent London cotton broker who acquired the property along with a sizeable cattle ranch, just as the completion of the coast line of the Southern Pacific in 1886 caused the discontinuance of the slower and less comfortable but more picturesque stages.

By this time the large Spanish grants, with their vague boundaries, had passed from the hands of the grantees. The vast areas of grazing land were divided into grain ranches.

The coastal valley between the mountains and the ocean from Ventura to Hueneme was given over to raising grain. Previous to the advent of the railroad the grain from this valley was hauled to Hueneme and shipped from there by boat.

The valley land from the Conejo grade to Cahuenga Pass, at Hollywood, was devoted to the same type of farming. Los Angeles provided the market and delivery was made by eight- and 10-horse teams pulling two large wagons in tandem.

Horse and Buggy Road

It was as a county road serving these ranches in the horse and buggy days that this road, now known as Ventura Boulevard, passed into the control of the California Highway Commission as State Route 2.

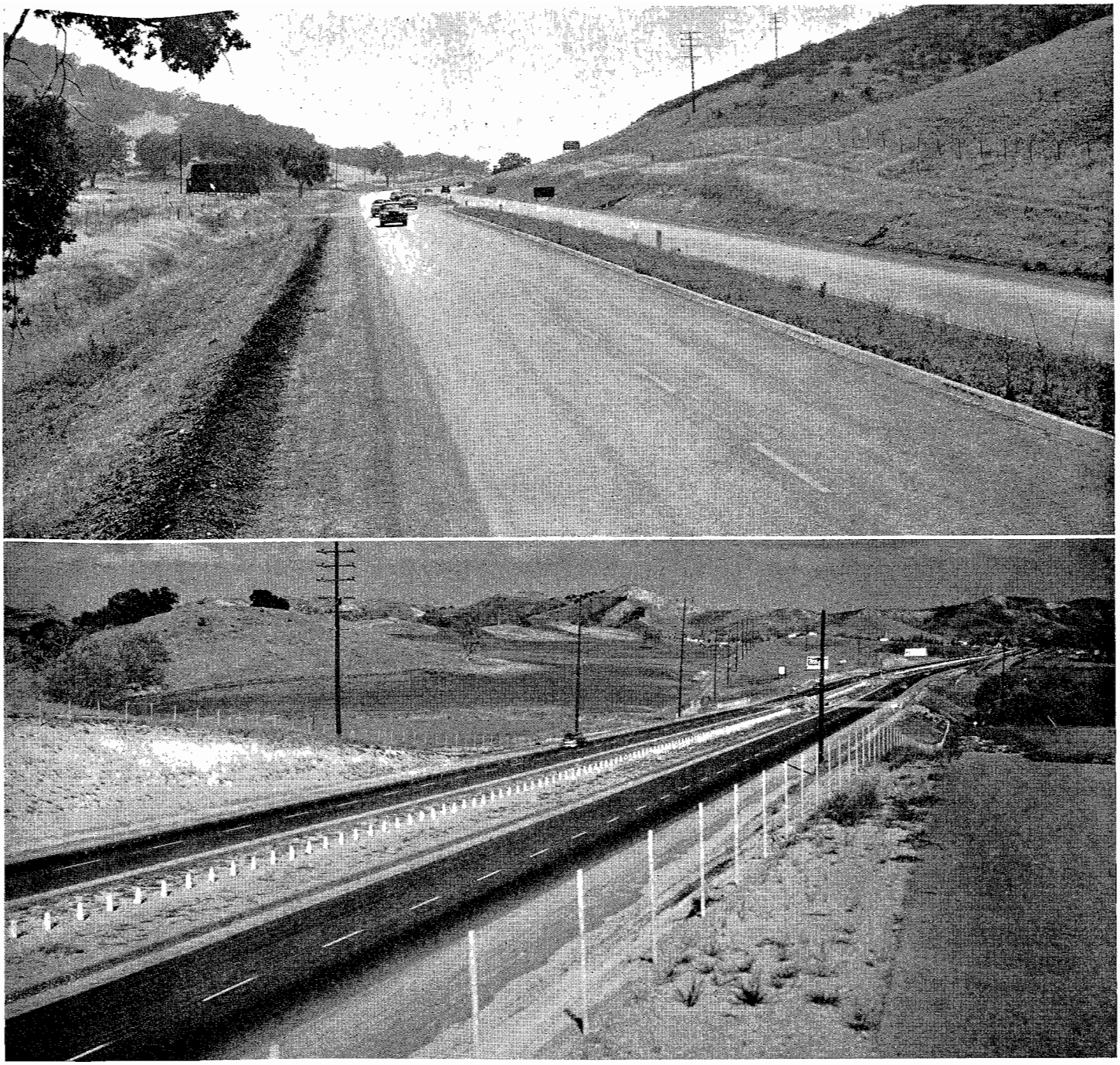
Construction of the highway commenced in December 1912 at Ventura and Lankershim Boulevards, proceeding through the grain fields of the Lankershim ranch for seven and a half miles. As shown by the accompanying photograph taken during paving operations near what is now Studio City, the San Fernando Valley at this time was very sparsely settled. In fact, aside from the wheat fields of the Lankershim and Van Nuys ranches and a few apricot and peach orchards at Owensmouth (Reseda), Lankershim (North Hollywood) and Van Nuys, the area between Ventura Boulevard and San Fernando Road, was covered with chaparral.

The old adobe landmark at Encino was at that time the headquarters of an active ranch, grazing large flocks of sheep over the Hollywood hills.

This contrast was followed by the construction of the Chalk Hill Grade, whose meanderings are still visible, and in rapid succession subsequent contracts extended the 15-foot width of four-inch thickness concrete pavement from Calabasas over the Conejo Grade through El Rio to Ventura. This two-lane pavement was completed from Cahuenga Pass to Ventura by 1917.

Progressive Improvement

At various times during succeeding years this stretch of roadway was improved by realignment and resurfacing to provide, generally, a 20-foot concrete pavement.



UPPER—Completed Spicer contract past Calabasas. LOWER—Completed Kiewit contract, looking south from Media Creek toward Agoura

As Ventura Boulevard northerly from the present end of the Hollywood Freeway at Vineland Street in North Hollywood to Calabasas, is now a Los Angeles City street, the reconstruction and maintenance of this section of the highway is under the jurisdiction of the City of Los Angeles.

The first step in the evolution of this road from a two-lane roadway to a four-lane divided highway with limited access, was the completion in October 1948 of a one and one-half mile section extending northerly from the city limits of Los Angeles at Calabasas.

In August 1949, Peter Kiewit Sons' Company finished 3.2 miles of similar type construction, completely by-passing the community of Agoura. While the old pavement through Agoura, with its many sharp curves and rolling grade, was the source of much delay and annoyance to through traffic, it remains as an adequate service road for the village. Convenient access to the new highway is provided at three locations.

Filling in Gap

Filling in the gap between the two completed sections mentioned above, rapid progress is being made on four and one-half miles under contract to Basich Bros. Construction Company and Basich Bros. of Los Angeles. On the southerly third of this section the

Near Calabasas, showing heavy grading operations in progress, with public traffic passing through construction

existing right of way is included to some extent in the realignment but the northerly two-thirds is almost entirely separated from the present roadway.

These three contracts are of a similar deisgn calling for heavy grading and long haul of excavated material from cut to fill. The pavement consists of two roadways, each paved with a 29-foot width of plant-mix surfacing supported by an 8-inch blanket of untreated rock base over a variable thickness of subbase and lined with a five-foot bituminous-treated shoulder.

With the exception of plant-mix surfacing on the Spicer contract, the subbase material, untreated rock base and paving aggregates for these three contracts have been or will be secured from local sources and crushed, screened and blended by the contractor's equipment. It is expected that in the near future bids will be received for the further extension of divided highway 6.6 miles through Thousand Oaks almost to Newbury Park.

During the 38 years since this road became a part of the State Highway System great changes have occurred in the Conejo Valley. Under the trees at Thousand Oaks (then the Crowley Ranch) where the brood mares and their frisky young offspring made a picture of complete contentment, elephants and their progeny now portray absolute indifference and resignation.

The mental attitudes of the lions, leopards, tigers and other occupants of the "Wild Animal Compound" now located under these same trees, are a matter of conjecture. The trim well-kept homes and gardens in this valley give the impression that here live people who have found a haven of peace and well being.

No Parking

Continued from page 53 . . .

Newer applicants, seeing the slight usage being made of such lots, have invariably protested the requirement and it has been difficult for the planning commission to get the amount of off-street parking they knew some day would be needed without antagonizing applicants. The all-inclusive parking ban will now cause each owner of a new business to be as interested as the planning commission in providing sufficient space for his future customers.

Chief of Police F. D. Bentzen and other officials mention other incidental improvements in driving conditions they have already noticed. Cross traffic at unsignalized intersections is moving across with less delay than formerly when large trucks, parked adjacent to the intersections, restricted visibility. In the past, school children on bicycles and scooters were forced to swerve out from the curb into the lane of travel when reaching each group of parked cars. The danger of them being struck by overtaking vehicles was always present, and a few accidents of this type have occurred. Now the children follow a reasonably straight path close against the curb. Drivers entering the highway on a right turn now move out much more rapidly and confidently into the curb lanes. In the past such drivers often were forced to wait long periods for a safe gap in the line of vehicles using the one lane. Since the one former lane in each direction was 15 feet wide, many drivers made left turns from the right portion of the lane. Proper left turns from the inner lane have already largely superseded the previous hazardous maneuvers. Mothers mention a new sense of relief from the fear that their children might step out from between parked cars.

Thus the farsighted officials of Visalia, while recognizing that State Highway Route 10 must soon be widened and otherwise improved by application of modern highway design principals, have acted wisely and boldly to relieve congestion, delay and hazard, until funds are available for a major improvement, by prohibiting parking along almost the entire length of that route through the city. The change has achieved a marked success. It has greatly reduced congestion and delay, has speeded up traffic flow but not to a dangerous extent, and gives clear promise of causing a substantial decrease in accidents.

EARL WARREN
Governor of California

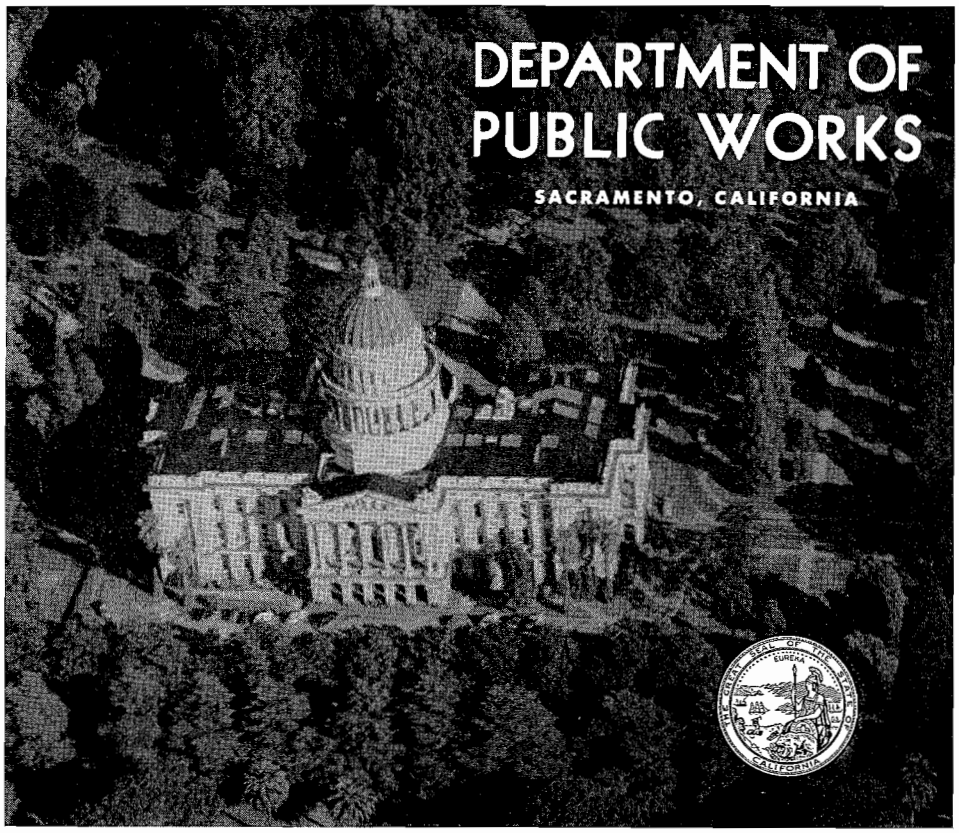
•

CHARLES H. PURCELL
Director of Public Works

•

FRANK B. DURKEE
Deputy Director

•



HIGHWAY COMMISSION

C. H. PURCELL . . . . . Chairman
HARRISON R. BAKER . . . . . Pasadena
HOMER P. BROWN . . . . . Placerville
JAMES A. GUTHRIE . . . . . San Bernardino
F. WALTER SANDELIN . . . . . Ukiah
CHESTER H. WARLOW . . . . . Fresno
CHARLES T. LEIGH . . . . . San Diego

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
FRED J. GRUMM . . Deputy State Highway Engineer
J. G. STANDLEY . . Assistant State Highway Engineer
R. M. GILLIS . . . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
T. E. STANTON . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
C. E. WAITE . . . . . Engineer of Design
EARL WITHYCOMBE . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . Equipment Engineer
H. C. McCARTY . . . . . Office Engineer
J. C. YOUNG . . . . . Traffic Engineer
J. C. WOMACK . . . . . Planning Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . . Comptroller

Right of Way Department

FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
E. M. MacDONALD . . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

District VII

P. O. HARDING . . Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . . District I, Eureka
J. W. TRASK . . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . District V, San Luis Obispo
E. T. SCOTT . . . . . District VI, Fresno
W. L. FAHEY . . . . . District VII, Los Angeles
M. E. CESSNA . . . . . District VII, Los Angeles
E. Q. SULLIVAN . . . District VIII, San Bernardino
S. W. LOWDEN . . . . . District IX, Bishop
JOHN G. MEYER . . . . . District X, Stockton
E. E. WALLACE . . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . . Chief
GEORGE C. HADLEY . . . . . Attorney
HOLLOWAY JONES . . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. R. SIMPSON
Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . . State Architect
W. K. DANIELS . Assistant State Architect (Administrative)
P. T. POAGE Assistant State Architect (Design and Planning)
D. C. WILLETT . . . . Chief Construction Engineer

Headquarters

A. F. DUDMAN . . . Principal Architectural Designer
C. L. IVERSON . Supervising Architectural Draftsman
CARLETON PIERSON . Supervising Specification Writer
FRANK A. JOHNSON . . Principal Structural Engineer
C. A. HENDERLONG
Principal Mechanical and Electrical Engineer
WADE HALSTEAD . . . . . Supervising Estimator

Schools

W. H. PETERSEN Principal Structural Engineer, Sacramento
H. W. BOLIN . Principal Structural Engineer, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 27899 7-50 26,400

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. BOX 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

CALIFORNIA STATE HIGHWAY SYSTEM